

Globalisation and growth nexus: Evidence from Africa through Granger Causality and Wavelet Coherence

Piyara Wijesuriya^a, Dinithi Athalage^a, Danushi Rathnayake^a, Irushi Sandanayaka^a,
Ruwan Jayathilaka^{b,*}

^a SLIIT Business School, Sri Lanka Institute of Information Technology, New Kandy Road, Malabe, Sri Lanka

^b Head Department of Information Management, SLIIT Business School, Sri Lanka Institute of Information Technology, New Kandy Road, Malabe, Sri Lanka

ARTICLE INFO

Keywords:

Economic growth
Globalisation
Economic globalisation
Social globalisation
Political globalisation
Africa

ABSTRACT

This study analyses the causal relationship between economic growth with globalisation and its economic, social and political facets in 33 African nations, for 51 years from 1971 to 2021. On an empirical perspective, the Granger Causality Test is utilised in the cross-country analysis, with the Wavelet Coherence methodology being conducted to comprehend the growth-globalisation nexus for the African region. Conceptually, the study is based on the Endogenous Growth and Dependency theories in identifying how globalisation drives growth in Africa. Unidirectional causal flows between globalisation and growth have been revealed for Benin, Burundi, Cameroon, Côte d'Ivoire, Kenya, Mauritania, Seychelles, Sierra Leone, and Uganda. Bidirectional causal flows between globalisation and growth have been revealed for Eswatini, Egypt and Rwanda. The study also suggests the strengthening of economic, social and political integrations, leveraging natural resources for sustainable growth, and cultivating resilience against external shocks while extending targeted support for low-performing nations in the region as strategies to improve the globalisation-growth nexus in the region. The study contributes to the existing literature by providing a holistic assessment of the growth-globalisation dynamics in Africa and its regional nations, extending over five decades, and using a dual-method approach.

1. Introduction

Globalisation refers to the coalescence of economies, societies, and governments despite national borders [1]. Economic Growth is defined as a country's increased potential to produce goods and services over the long term, stimulated by capital accumulation, technological development, labour growth and governmental policies [2–4]. The link between these two phenomena has been of interest to researchers, thereby resulting in numerous studies since the turn of the century. During these times of economic, political, technological, and environmental adversities, further explorations to understand this nexus is even more crucial to allow all nations to thrive within this integrated system.

Fig. 1a and 1b depict the average levels of economic growth and overall globalisation documented across the world regions during the recent half-century. Accordingly, it is observable how the African region has recorded the lowest ranks in both dimensions. This suggests how the development efforts and the impact exerted by global integration experienced by the region have fallen behind its regional counterparts.

The region being comprised mostly of developing and underdeveloped countries facing poverty, not being equipped with standard infrastructure and human capital indicators, experiencing political instability and being equipped with the bare minimal degrees of industrialisation can be identified as rational causes for this observation. The analysis of the globalisation-growth link in Africa can assist in uncovering insights to shape holistic strategies for regional growth and economic resilience and facilitate inclusive global economic growth through investments on global integration. Exploration of this nexus also enables the bridging of a vital scholarly gap where the African region remains underexplored despite the potential to contribute innumerable insights to the global economic discussion.

Hence, this study considers 33 nations in the African region and extends over 51 years from 1971 to 2021, bounded by the availability of data. The selected period also enables accounting for both short-term shifts, long-term trends, global structural changes, and historical comparisons to result in a thorough evaluation of the respective transforming interrelation between economic growth and globalisation.

* Corresponding author.

E-mail address: ruwan.j@slit.lk (R. Jayathilaka).

<https://doi.org/10.1016/j.sfr.2025.100833>

Received 30 November 2024; Received in revised form 5 April 2025; Accepted 8 June 2025

Available online 9 June 2025

2666-1888/© 2025 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Furthermore, the study utilises the Konjunkturforschungsstelle (KOF) Globalisation Index [1], widely utilised in similar literature [5,6]. The index allows to quantify the multidimensional nature of globalisation by integrating crucial elements of economic, social, and political sub-dimensions of globalisation. In this regard, the use of this index eliminates the need for additional variables and allows conducting a focused analysis while reducing redundancy. Accordingly, the study aims to accomplish the following objectives with respect to the African nations considered,

1. To determine the direction of causality between globalisation and economic growth.
2. To determine the direction of causality between economic globalisation and economic growth.
3. To determine the direction of causality between social globalisation and economic growth.
4. To determine the direction of causality between political globalisation and economic growth.

In this regard, the study aims to add to the existing body of related scholarly discourse in the following three ways. While previous studies have focused only on the interrelation between economic growth and the overall and the economic facets of globalisation, the social and the political dimension in this association remains underexplored. Firstly, with the intention to bridge the existing gap in literature and ensure a comprehensive analysis, this study considers equally all facets of globalisation when investigating the balance between globalisation and growth.

Secondly, the study aims to make a methodological contribution by following a dual-methodological analytical approach. The cross-country analysis is conducted using the Granger Causality test; a popularly utilised methodology in causality analysis to detect the one-way and two-way causal flows between the considered variables in respect of the selected 33 nations. The study also utilises the Wavelet Coherence approach in conducting the regional analysis, a sophisticated statistical approach enabling the identification of unidirectional and bidirectional causalities between the variables with respect to time (short-term, medium-term, and long-term), frequency scopes (low, medium, and

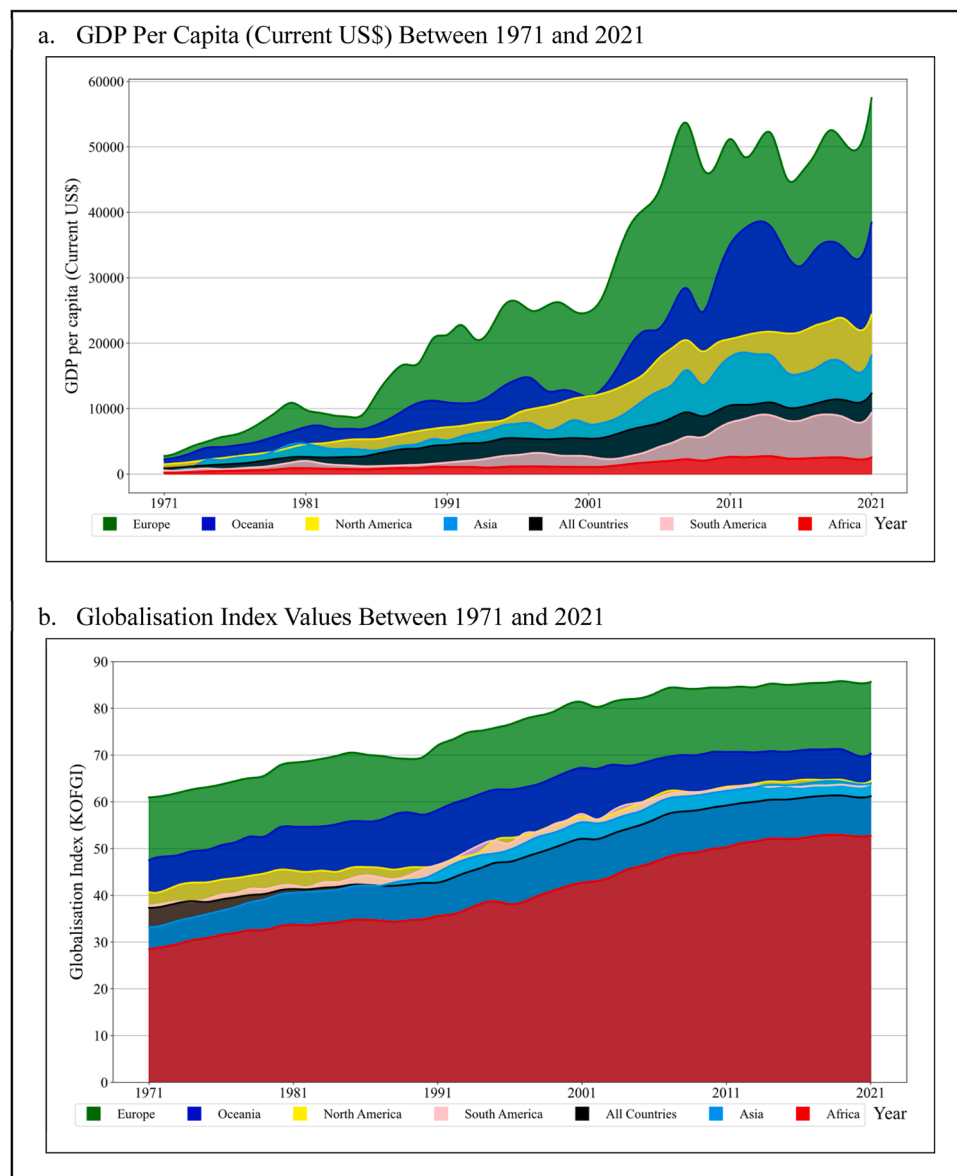


Fig. 1. Trend Analysis of Economic Growth and Globalisation Across Regions.
Source: Authors' illustration.

high) and the direction of the correlation (positive, negative and mixed).

Thirdly, the study aims to contribute through sustainability-focused policy insights. Considering Africa's dedication to the 20230 Agenda for Sustainable Development and the Agenda 2063: The Africa We Want, which is an endeavour to transform the region into an international powerhouse by year 2063, the study suggests policy recommendations for each of the nations considered, in line with United Nations Sustainable Development Goals, to facilitate regional sustainable development and global integration.

The remainder of the paper comprises of a critical review of related scholarly studies, a detailed description of the data and methodologies utilised, a presentation and discussion of the study's findings, and the policy suggestions developed thereof.

2. Literature review and the theoretical basis

A comprehensive critical review of the existing research related to the African globalisation-growth nexus, along with a review of the theoretical concepts underpinning the study are comprised in this section.

2.1. Literature review

Existing literature relevant to the study was obtained by examining leading literature databases such as Science Direct, Springer, Taylor & Francis, Wiley Online, and Google Scholar. Primarily 348 journal articles were reached via basic search, duplicates and beyond the scope of Africa were excluded, resulting in 34 compatible studies, of which the process has been visualised in the Fig. 2.

Accordingly, a critical literature review was conducted thoroughly analysing studies thus identified based on the nexus of economic growth and globalisation discussed.

2.2. Critical literature review

Globalisation is a dynamic phenomenon which has diversely impacted the economic landscape of Africa over time. The overall, globalisation tends to exert a positive influence on economic growth [7–12], and on economic participation of women in the African region [13]. Furthermore globalisation presents a significant impact on economic growth in African low-income nations [14] while positively influencing economic growth [6,15]. However, at times, globalisation elevates growth rates up to a certain level and then shows a negative impact presenting a non-linear influence on economic growth in Africa

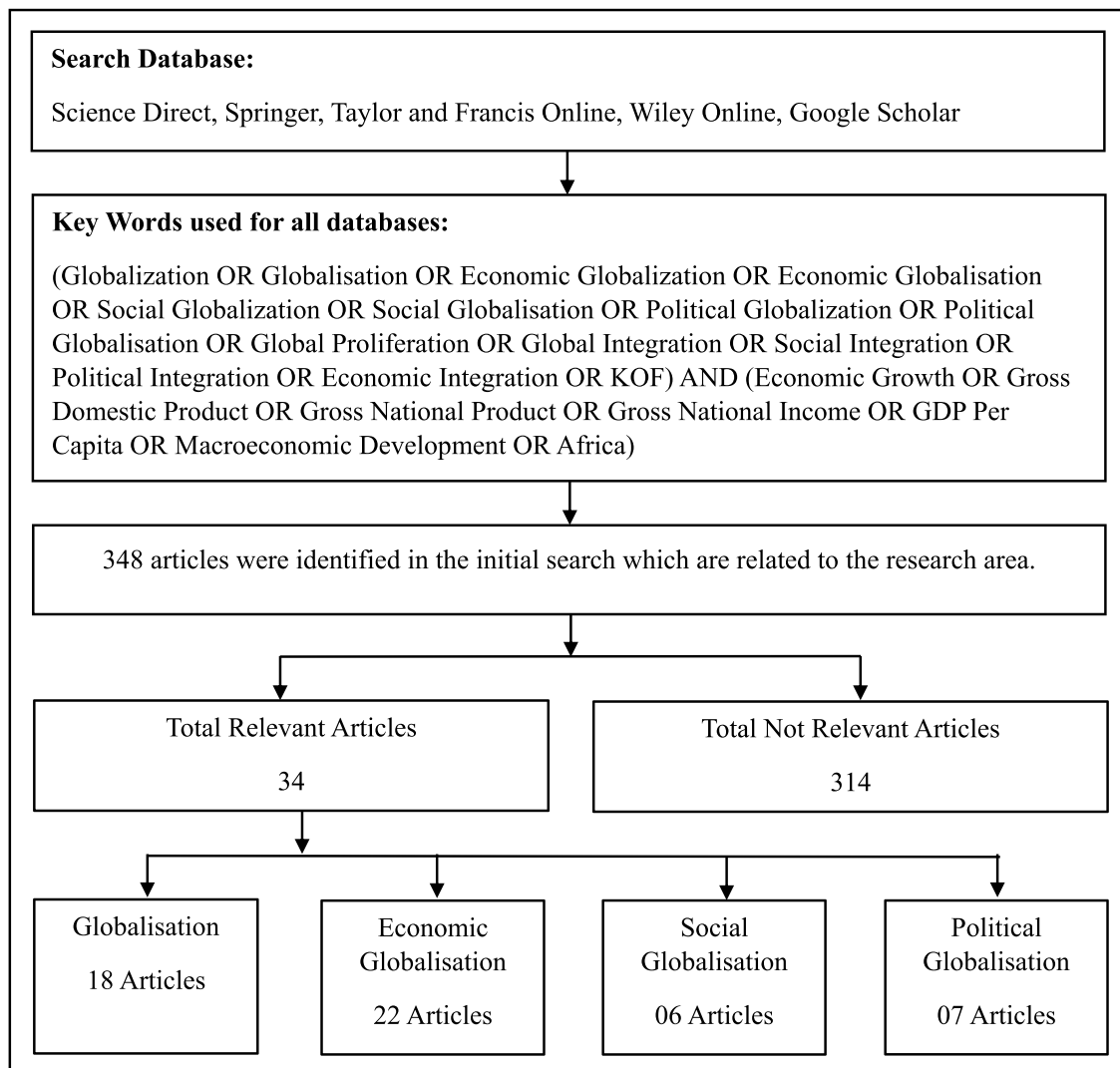


Fig. 2. Literature search strategy.
Source: Authors' illustration.

[12]. Accordingly, globalisation can be identified as a dynamic which promotes the expansion of the African economies with a significant impact.

Overall globalisation promotes trade openness while elevating economic growth rates in South Africa studied as nation under Newly Industrialised Countries (NICs) [16]. Furthermore, a one-way causal link from overall global integration towards economic performance was documented in South Africa [17] whereas, globalisation acts as a determinant affecting the financial sector development in South Africa and Nigeria in the long term [18]. It was also revealed how a statistically significant, positive and an elastic effect is exerted by the overall economic integration on the growth rates in Nigeria [19]. A detrimental impact of overall globalisation on economic growth was discovered in Ghana [20]. One-way causal flows from globalisation to economic growth were discovered in South Africa and Ghana while bidirectional causal relationships were found in Kenya and Nigeria [5]. A two-way causal relationship was disclosed between global integration and economic proliferation pertaining to South Africa being a part of BRICS economies [21]. Similar bi-directional dynamics were also revealed in Egypt and Nigeria, substantiating how global integration allows the interchange of knowledge, technology and goods, and is especially beneficial for the developing sector [22]. As opposed to the positive dynamics observed in the overall African region, the globalisation-growth nexus of standalone nations tend to vary between positive and negative causal flows.

Economic integration along with its financial and trade facets, were identified to be facilitators of economic enhancement in the African region [9,23,24]. Actual flows were found promoting female economic participation in Africa [13]. In the sub-regional context, foreign direct investments tend to positively impact economic growth in West Africa [10]. Both exports and foreign direct investments were identified having a significant causal relationship with growth in Sub-Saharan Africa [25]. In North Africa, economic globalisation exerts a positive impact on economic expansion in the long run, and a negative effect in the short run [26]. On the contrary, economic integration influences negatively on the economic growth of low-income Africa [27]. Bidirectional interrelations were identified between economic globalisation and growth [6], and financial globalisation and growth [28], in the low-income Africa and Western Africa, respectively. Moreover, economic growth too tends to impact economic globalisation [20]. Therefore, though the economic globalisation-growth nexus in Africa varies with time horizon and sub-regional context concerned, the effect of the former on the latter in the overall African context can be cited as positive.

Economic globalisation was observed promoting higher growth rates in South Africa [29]. Financial and investment globalisations were also identified boosting [30] and exerted a significantly positive impact [31] on economic growth of African nations [32,33]. Actual flows were identified as promoting economic growth in Botswana, Zambia, Cote d'Ivoire, Burundi, Madagascar, Central African Republic, Niger, Congo, Sierra Leone, Mali, Chad, Uganda, Sudan, Rwanda, Lesotho and Eswatini. In contrast, economic integration was found hindering economic growth rates in Egypt and South Africa [34]. Restrictions associated with economic integration [35], and banking sector globalisation [36] were observed further curbing economic growth in nations in Africa. However, recent studies prove that free trade activities and certain aspects of urbanisation enhance sustainable economic growth and economic resilience [37,38] in other parts of the world pushing nations to higher income categories. Hence, the absence of trade liberalisation could be deduced as a possible restriction for economic expansion in the African region. Furthermore, a two-way casual progression was also detected between foreign direct investments and economic growth in a study that included 23 African countries [39]. It can be deduced that economic globalisation has an optimistic impact on economic growth in the African region at a cross-country context, though this effect tends to differ by the based on the constituents of economic globalisation.

Social and political globalisation exert negative and positive impacts

on economic expansion in low-income African nations respectively [27]. Although, social and political dimensions of globalisation act as stimulants of economic growth, 'access to the internet' which is a component of the social facet, hinders the economic expansion of Africa [9]. Political governance tends to have a positive impact on economic growth rates in the West African region [10]. Informational flows in social globalisation promote the financial participation of women in Africa, while the impact of political globalisation tends to be detrimental [13]. Accordingly, the impact exerted by the social and political dimensions of globalisation tends to take a mixed form in the entirety of the African region.

At a cross-country level, while social globalisation was identified to stimulate economic proliferation, political integration was found to impede growth in South Africa and Egypt [34]. Furthermore, positive effects of social and political integration on the economic enhancement were observed in Botswana, Zambia, Cote d'Ivoire, Burundi, Madagascar, Central African Republic, Niger, Congo, Sierra Leone, Mali, Chad, Uganda, Sudan, Rwanda, Lesotho and Eswatini [35]. Furthermore, both social and political globalisation promote economic expansion in low-income nations of the African region [6]. Hence, social and political dimensions of globalisation diversely impact the growth rates of the African nations. However, these dimensions are understudied in the existing literature.

2.3. Theoretical basis

To solidify the study's theoretical basis, concepts of the Endogenous Growth and Dependency theories are elaborated herewith, in order to explain why globalisation is a catalyst for growth in Africa.

The Endogenous Growth theory claims that a nation's economic productivity is inherent, driven by forces endogenous to a country. In this regard, the theory specifically focuses on the factors of human capital development and technological progress [40]. For Africa comprised mostly of lower-middle and low-income nations with weak economic and social infrastructure, the technological and global expertise, along with the capital necessary to facilitate this digital transformation, capacity building, and eventually the sustained regional economic prosperity is enabled through globalisation. Hence, the Endogenous Growth theory suggests a positive correlation and a bidirectional causal relationship between globalisation and growth in the African region, where increased levels of globalisation are likely to result in increased growth through the reinforcement of internal processes, while highly developed economies tend to portray a higher potential of being integrated to the global system.

Contrarily, the Dependency theory is a concept discerning the significance of exogenous forces of a nation in its pursuit towards prosperity. It asserts that the economic flows within the global economic system are structured to give rise to imbalances, thus resulting in structural reliance of the developing and under-developed economies on developed economies [41,42]. Rich in natural resources and being agriculture-oriented, Africa is compelled to export its production to global markets to satisfy their needs and wants, thus substantiating their dependence on exogenous forces. In this regard, the raw materials received by developed nations are transformed and sold as high-value products, thus proving the distortedness of the economics benefits disseminated. Accordingly, though globalisation may drive the trade stance of and the capital inflow to Africa, the Dependency theory suggests how it may not always be a stimulant of growth due to the resulting disproportionate economic benefits.

2.4. Identified gap in literature

Though it is seemingly evident from the above literature review as to how the globalisation-growth in the African region and its nations have been extensively investigated, certain gaps in the scholarly discourse still prevail.

1. It is identified how majority of the existing literature are short-term analyses considering the years of the globalisation era (1990 onwards). This potentially leads to a knowledge gap pertaining to the historical perspective on the globalisation-growth which existed prior to this era of globalisation.
2. It is observed that many studies which had generated findings related to the African region and its nations have been resulted through studies focusing either global, sub-regional, or low-income contexts, rather than focusing solely on the region. This sometimes leads to certain African-specific circumstances to be overlooked, while limiting the methodological consistency and the targeted nature of the policy implications developed.
3. It is also apparent how most of the studies focusing the globalisation-growth link in relation to Africa had largely considered the overall and the economic dimensions of globalisation, thereby disregarding the vital roles played by the social and political globalisation in this global economic discourse. Table 1 illustrates a comparative analysis of the type of globalisation considered by the literature considered within the literature review of this study. Accordingly, it is proved that the social and political integrations have been underexplored during the interrelation of this interrelation.

3. Data and methodology

This section comprises a detailed description of the variables studied in this study in conjunction with the statistical methodologies used in their analysis.

3.1. Data

This study employed a panel dataset considering 33 African nations over a period of 51 years, from 1971 to 2021. The data utilised in this regard is provided in Appendix A. Fig. 3 elaborates on the sources of data collection and the procedure followed in its analysis.

3.2. Methodology

This study evaluates the relationship between globalisation along with its three sub-dimensions at a cross-country level using Granger Causality test and at a regional level with panel data using Wavelet Coherence. The study contributes to the methodology with its capabilities in identifying bi-directional relationships over extensive periods of time. Granger Causality test provides an accurate evaluation of relationships across the selected 33 nations in the African region and Wavelet Coherence, being a sophisticated methodology, provides the causal progressions in the panel of 33 nations (regional) with frequencies across different terms.

3.2.1. Granger Causality test

Granger Causality test [43] is used as the second methodology in this study to test the causal relationships between the variables at a country level. This technique has been widely used for similar discussions which includes globalisation and economic growth by many researchers [24, 44–47] and many recent studies have been conducted discussing a multitude of other macro-economic variables [48–50]. However, this methodology requires stationarity and an optimal lag length to be determined before conducting the analysis.

The Dickey–Fuller unit root test [51] has been employed to determine the stationarity of the variables out of many existing unit root tests. Dickey–Fuller unit root test evaluates the stationarity of the time series data by identifying the existence of unit roots in the data. Eq. (1) states the statistical expression of the Dickey–Fuller unit root test utilised in this study. The term D_t delineates the vector of the constant and the λ depicts the regression coefficient. ε_t symbolises the error term of the unit root test.

$$y_t = \beta D_t + \lambda y_{t-1} + \sum_{j=1}^p \theta_j \Delta y_{t-j} + \varepsilon_t \quad (1)$$

In this endeavour, the null and the alternative hypotheses of the stationarity test to identify the existence of unit roots in the time series,

H_0 : Time series consist of unit roots (non-stationary data)

H_1 : Time series does not consist of unit roots (stationary data)

The variables which fail to reject the null hypothesis at 1% significance level were differenced and the same treatment is done until the variables are capable of rejecting the null hypothesis. However, number of differences are diverse across nations, and it is depicted by the letter ‘D’ prefix to the acronym of the variable in the results of this study. This test is widely used by researchers to evaluate the stationarity of macro-economic time series data which are often subjected to high number of irregularities. Hence it can affect the validity and reliability of the dataset used and the legitimacy of the findings related studies involving macro-economic variables [52].

The optimal lag length for the Granger Causality test was done utilising the lag selection criteria, Akaike’s Information Criterion (AIC) [53], Schwarz’s Bayesian Criterion (SBIC) [54] and the Hannan and Quinn Information Criterion (HQIC) [55]. Robustness checks to determine the validity of the results obtained from the optimal lag length, was conducted utilising alternative lag lengths in this study.

Eq. (2) is the general equation used in this context in evaluating the Granger Causality, which was substituted with GLO, EGLO, SGLO, and PGLO with GDP separately to determine the relationships.

$$Y_{i,t} = \sum_{k=1}^{\rho} \varpi_i Y_{i,t-k} + \sum_{k=0}^{\rho} \pi_k X_{i,t-k} + u_{i,t} \quad (2)$$

The independent and dependent variables are denoted by X and Y respectively, while i and t represent the country and the time duration in years respectively. ρ denotes the number of lags whereas, the frequency of lags is delineated by k . ϖ denotes the coefficient of regression and π is the constant values of regression where k may take any within the range from 1 to total observations in the population (1 to N). The error term in the equation is depicted by u .

Granger Causality provides a multitude of benefits as a widely used methodology in accurate evaluation of causal relationships between variables in time series data and possess the potential of precisely forecasting future values [56]. This methodology provides insights on the causal progressions between variables with both unidirectional and bidirectional impacts, hence it is highly favoured by researchers across a multitude of disciplines ranging from medical sciences [57,58] to social sciences [59,60]. Going by the objectives of this study, the time series dataset consisting of 33 countries across five decades is more suited to be analysed using this methodology at a cross-country level to obtain accurate and reliable findings.

3.2.2. Wavelet Coherence analysis

The Wavelet Coherence methodology [61], which measures the correlation and causality within time series data, was used in the context of this study to analyse the nature of the correlation and causality between GDP and each dimension of globalisation; GLO, EGLO, SGLO, and PGLO within the African region.

Utilised by previous studies [20,62] which had examined the interrelation between globalisation and economic growth, this methodology had also been highly favoured by researchers from the disciplines of Finance [63,64], Environmental Sciences [65–67], Biomedical Engineering [68], Climate Science [69] and the analysis of other socio-economic variables [70–72].

The Wavelet Coherence is statistically denoted as depicted in Eq. (3) where the contractions and the translation of a wavelet is expressed by a and b respectively, and the Morlet Wavelet function is symbolised by $\psi^{a,b}$.

Table 1

Articles as per the dimension of globalisation respective to the country level representation.

Country	Globalisation	Economic Globalisation	Social Globalisation	Political Globalisation
Algeria	5	6	-	1
Angola	6	4	1	1
Benin	8	11	3	3
Botswana	7	8	1	1
Burkina Faso	5	7	-	1
Burundi	7	9	2	1
Cabo Verde (cape)	4	4	1	1
Cameroon	9	11	1	2
Central African Republic	7	9	2	1
Chad	8	7	2	2
Comoros (the)	5	6	1	-
Congo	9	10	2	2
Côte d'Ivoire	8	11	2	3
Democratic Republic of the Congo (the)	10	10	3	3
Djibouti	2	6	1	-
Egypt	6	8	-	2
Equatorial Guinea	4	3	1	1
Eritrea	3	5	1	-
Eswatini	4	7	1	-
Ethiopia	7	8	2	2
Gabon	7	7	1	1
Gambia (the)	6	8	1	1
Ghana	12	14	2	3
Guinea	8	8	1	2
Guinea-Bissau	6	8	1	1
Kenya	10	11	2	2
Lesotho	3	8	1	-
Liberia	5	8	1	1
Libya	2	3	-	-
Madagascar	7	8	2	2
Malawi	7	9	2	1
Mali	7	11	2	2
Mauritania	7	9	1	2
Mauritius	6	8	1	-
Mayotte	2	-	-	-
Morocco	5	8	-	1
Mozambique	9	10	2	2
Namibia	8	8	1	1
Niger	8	12	3	3
Nigeria	11	13	2	3
Rwanda	7	11	2	1
Sao Tome and Principe	3	3	1	-
Senegal	8	12	2	3
Seychelles	3	4	1	-
Sierra Leone	8	11	2	2
Somalia	3	2	1	-
South Africa	12	13	1	2
South Sudan	2	1	-	-
Sudan (the)	7	5	1	1
Tanzania	9	12	3	3
Togo	9	9	3	4
Tunisia	5	8	-	1
Uganda	7	10	2	1
Zambia	7	10	2	2
Zimbabwe	7	11	2	2
Western Sahara	1	-	-	-
Réunion	1	-	-	-

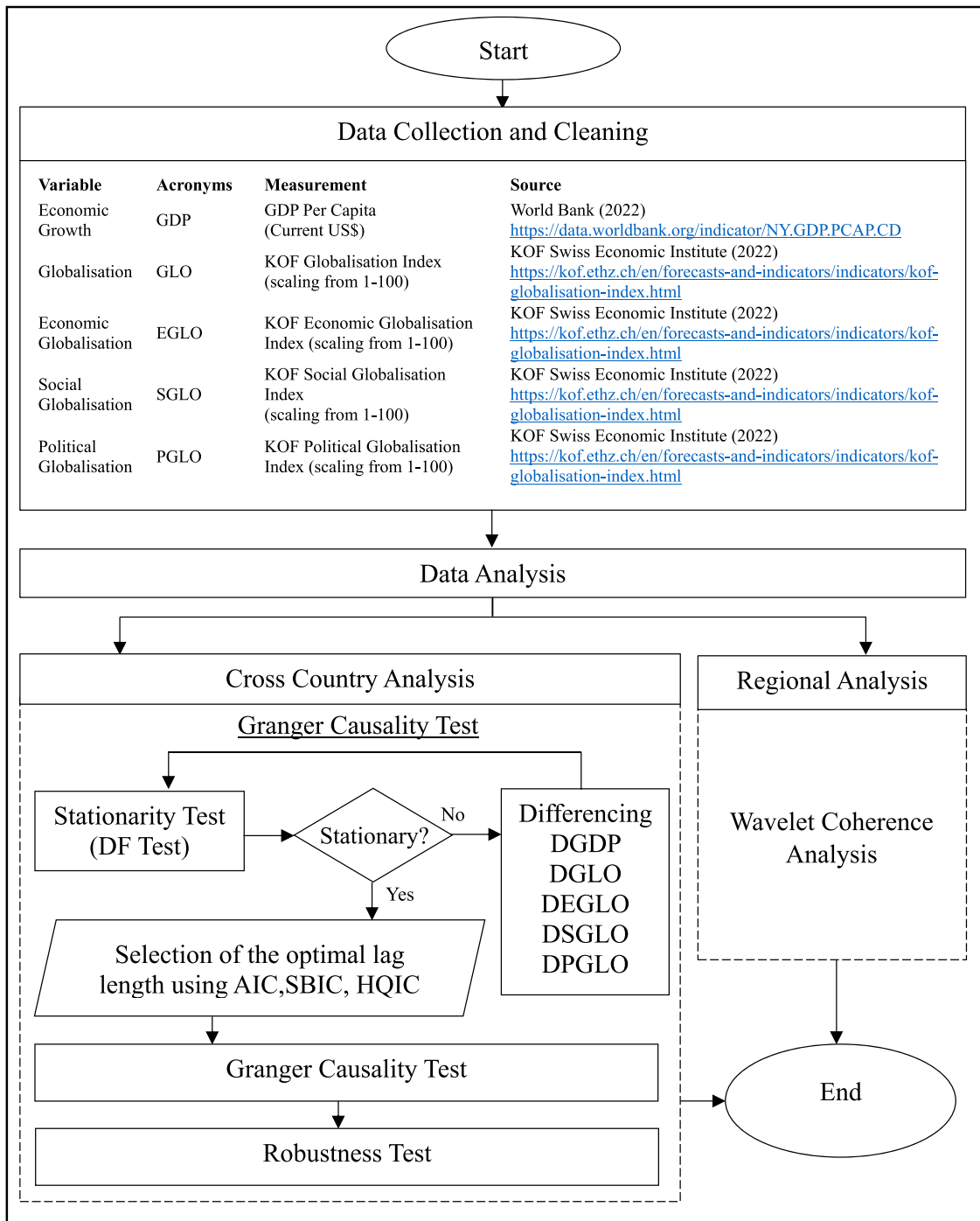


Fig. 3. Data and methodology flow diagram.
Source: Authors' compilation.

$$\psi^{a,b}(x) = |a|^{-\frac{1}{2}} \psi\left(\frac{x-b}{a}\right) \quad (3)$$

This methodology is a sophisticated technique used to analyse relationships between variables in panel data. Wavelet Coherence provides many benefits which cannot be obtained by other statistical techniques. Hence, as a methodology recognised as refined, Wavelet Coherence allows the elaborate detection of how the interrelationships existing between variables vary with frequency and how a particular variable will cause and influence another with more correspondence to the period (short-term, medium-term, and long term), in contrast to methodologies discerned as conventional. This methodology also allows

more complicated data relationships to be portrayed graphically, thereby aiding convenient comprehension, interpretation, and communication [73,74]. All the Wavelet Coherence graphs used for the analysis of this study had been generated using the R software.

The Endogenous Growth Theory states that a bi-directional causal progression with positive correlation tends to exist in the African region in the context of economic growth and globalisation. This phenomenon was identified majorly in low and lower middle-income nations which are abundant in the African region with drawbacks in their economic and social structures. On the contrary, the Dependency Theory implies that economic integration may not foster growth in African nations due to their dependence on exogenous forces. Hence, with the deployment of

Granger Causality [75] across 33 African nations and Wavelet Coherence to the African panel, this study identifies confirmations and arguments with the findings to the Endogenous Growth and Dependency Theories.

4. Results and discussion

This section entails the findings of a descriptive analysis, and the Granger Causality analysis conducted country-wise for the 33 African nations in consideration, along with the Wavelet Coherence analysis conducted for the entirety of the African region. Furthermore, the outcomes thus identified have also been discussed in this section in

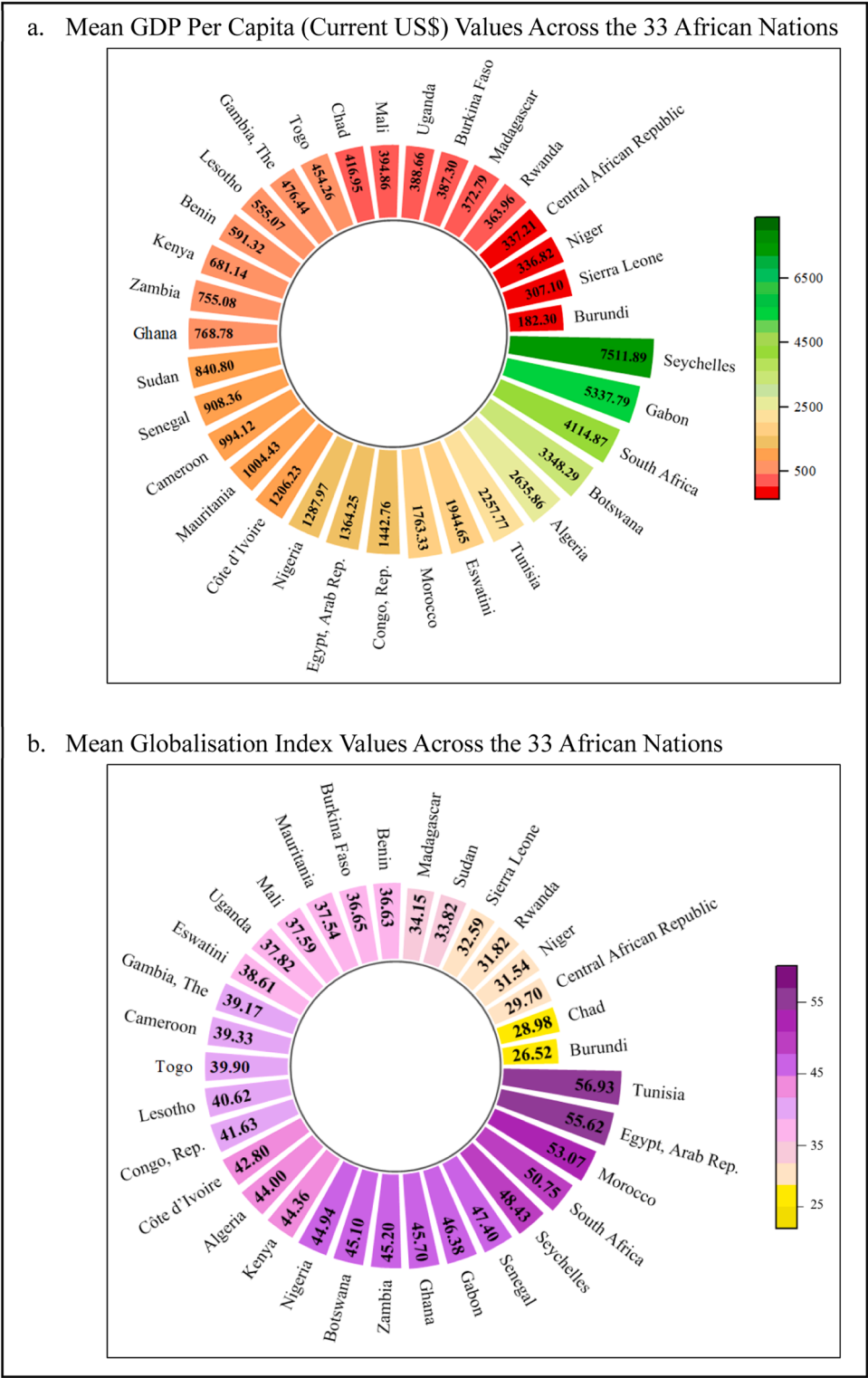


Fig. 4. Average economic growth and gloablisation values between 1971 and 20210.
Source: Authors' illustration.

conjunction.

4.1. Cross-country analysis

4.1.1. Descriptive analysis

Appendix B presents the summary statistics obtained pertaining the 33 African nations considered. As depicted in Fig. 4a the lowest average GDP per capita value in this region is documented in Burundi, while the highest is observed in Seychelles. In the context of globalisation as presented in Fig. 4b the minimum mean globalisation index value has been recorded by Burundi, whereas the maximum by Tunisia.

The map of the African region illustrated in the Fig. 5 above delineates the overall average growth rates of GDP per capita recorded by the 33 nations during the study's period.

The growth trajectory during this period has been headed by Nigeria, Sudan, Botswana, Seychelles, Gabon, Rwanda, Lesotho, and Congo Republic. Chad, Sierra Leone, Senegal, Central African Republic, Niger, Zambia, Madagascar, and Burundi can be classified into the bottom quartile due to the comparatively minimal progression trajectories observed. At the same time, the rest of the nations have depicted moderate economic progression movements.

Similarly, the African map visualised in the Fig. 6 below demonstrates the average growth of globalisation values for the selected African countries, while the respective average growth movements of the subdimensions of globalisation have also been portrayed in column charts.

Accordingly, the highest growth rates in the context of globalisation levels in the African region have been documented by Burundi, Rwanda, Niger, Chad, Ghana, Benin, Sierra Leone and Mali. Contradictory to this prominent sect, Côte d'Ivoire, Lesotho, Eswatini, Congo Republic, Botswana, Tunisia, Seychelles, and Gabon were identified as falling to

the bottom quartile owing to the reduced growth, despite still being a growth.

In the context of economic globalisation levels, while all nations have depicted even an incremental growth, this statement cannot be proven as relevant for Gabon who is observed to have maintained a stunted growth during the duration. The prime growth rate of economic globalisation has been documented in Sudan, while Botswana records the minimal. The average expansion in terms of social globalisation aspect is led by Burundi, with Seychelles holding the terminal position. With Botswana leading the region in the averaged progression levels of political globalisation, Tunisia has ranked last in this respect.

4.1.2. Granger Causality analysis

The results of the Dickey-Fuller test conducted to ascertain the stationarity of the variables; GDP, GLO, EGLO, SGLO, and PGLO before conducting the Granger Causality analysis, have been presented in Appendix C. With respect to GDP, GLO, EGLO, and SGLO, all African nations achieved stationarity when differenced for once (DGDP, DGLO, DEGLO, DSGLO). In the context of PGLO, all nations except for Egypt Arab Republic and Ghana had to be differenced once to achieve stationarity (DPGLO).

After the determination of stationarity, the stability of the model should be verified. This pre-requisite was fulfilled by identifying optimal lag length; the lag count minimising each of the lag selection criteria, AIC, SBIC, HQIC. The Granger Causality analysis, of which the findings are presented in Appendix D, was performed after the verification of these stationarity and stability conditions.

The results obtained through the Granger Causality approach suggest the existence of a bidirectional interrelation between economic growth and globalisation in the nations: Eswatini, Rwanda, and Egypt in the African region. However, the existing body of literature slightly

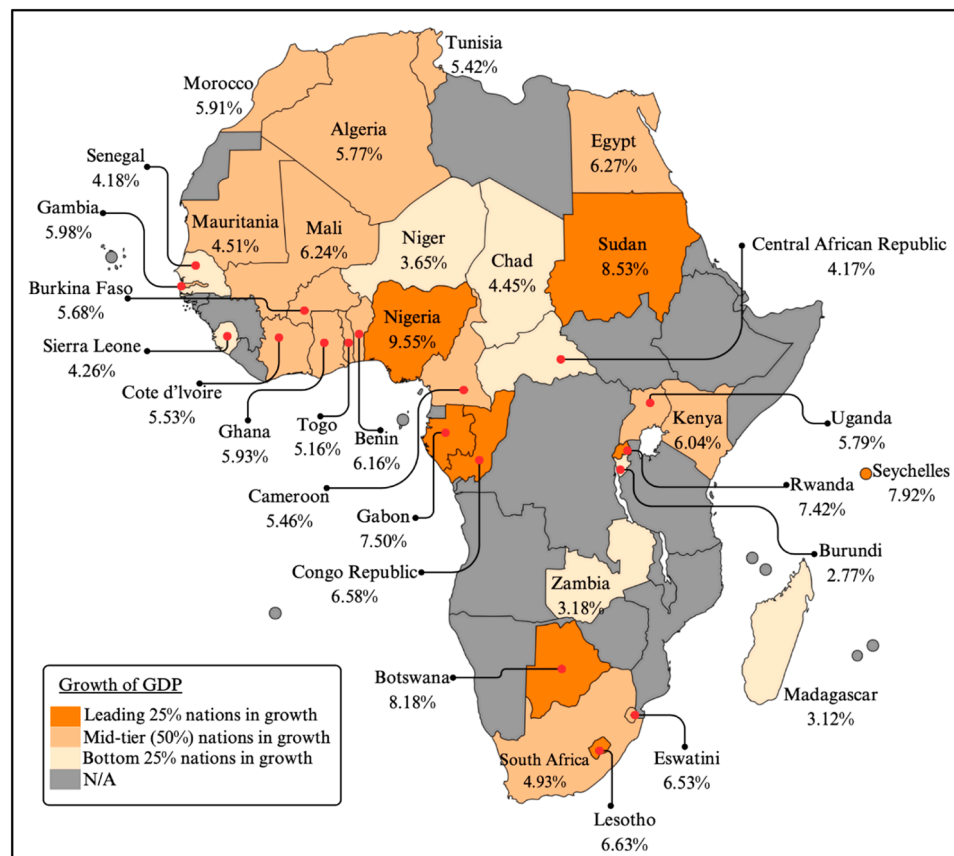


Fig. 5. Average growth of GDP per capita over the 51 years.
Source: Authors' illustration.

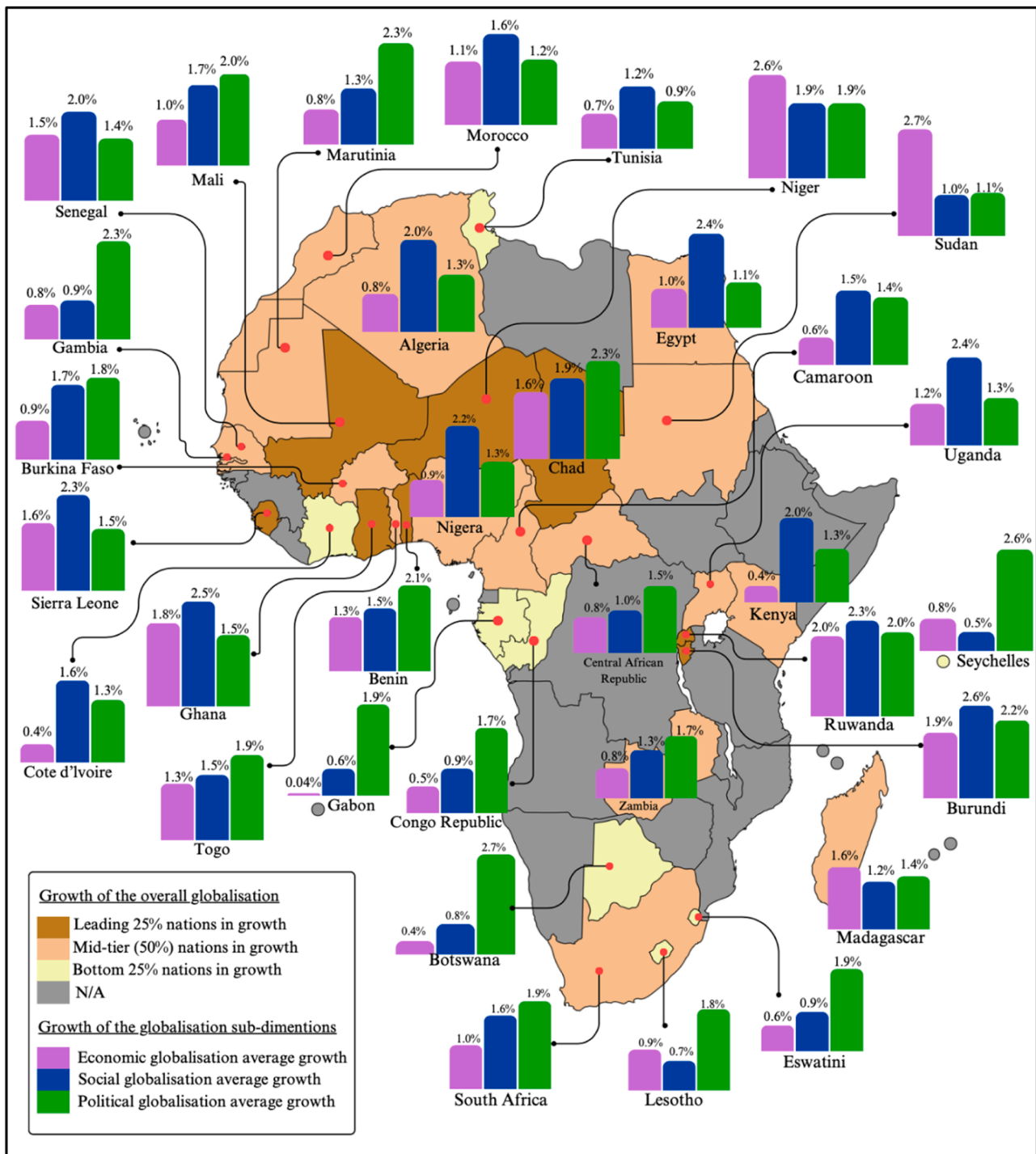


Fig. 6. Average growth of the globalisation values across 51 years.
Source: Authors' illustration.

contradicts with the two-way causal flow in terms of Rwanda which mostly presents a one-way causal flow from globalisation to economic growth [27] but confirms the bidirectional causal progression in Egypt [22]. Rwanda is considered as the third most thriving economy in the African region, being a nation affected heavily by a civil war in the 1990s owing to the high institutional quality and foreign direct investments [76]. Furthermore, Rwanda and Eswatini are nations comprised in the African Continental Free Trade Area and it widened the pathways to the global market along with a rapid technology transfer [77]. Egypt, being a highly populated nation, relies heavily on human

capital while facing a high level of unemployment as well [78]. However, the contribution of its labour market to the economic growth aspects influences globalisation and opens opportunities for the global markets. Furthermore, economic growth was found to granger-cause globalisation in Côte d'Ivoire, Kenya, Mauritania, and Seychelles. At the same time, a one-way causal flow from globalisation to economic growth was detected in Benin, Burundi, Cameroon, Sierra Leone, and Uganda. These findings correspond with the existing literature confirming the impact of globalisation on economic expansion across the specific African nations [27]. However, Algeria, Botswana, Burkina

Faso, Congo, Rep., Gabon, Lesotho, Madagascar, Mali, Morocco, Niger, Tunisia, Zambia, and Ghana records the absence of statistically significant associations between the globalisation and economic growth in the African region contradicting with the existing body of literature [12,27].

The presence of a two-way relationship between economic globalisation and growth was only revealed in Burkina Faso. Being a terrestrially bound low-income nation, it has in the recent years exerted efforts at trade liberalisation and restructuring its private and public enterprises, while being granted access to both global and sub-regional markets through trade partnerships such as Everything But Arms and Economic Community of West African States (ECOWAS) [79]. The enhanced engagement in international trade, inflow of foreign capital, market competitiveness and the economic efficiency and effectiveness through such efforts can be potential factors for this symbiotic relationship between growth and economic globalisation in Burkina Faso.

Economic growth was identified to granger-cause economic integration in Côte d'Ivoire, Eswatini, Mali, Rwanda, and Egypt, implying how internal growth achieved by these nations facilitate their incorporation to the global economy. The significant economic proliferation achieved by Rwanda through the amplification of domestic investments, exports, agricultural productivity, and the advancement of its commercial sectors [80], exports contributing to Eswatini's economic growth thereby strengthening its international relations and increasing its integration into regional trade blocs such as the South African Customs Union (SACU) [81], increased investment efforts to reduce infrastructural deficits, agricultural exports diversification, and the technological advancements in Côte d'Ivoire [82], along with the economic reform efforts performed by Egypt through the transition of its economy to a market-oriented system, promotion of privatisation, and uplifting revenues from the tourism industry [78], characterises development actions leading trade and financial globalisation in these economies.

The causal impact was identified to flow from economic globalisation to economic progress in Benin, Botswana, Gabon, Madagascar, Morocco, and Sierra Leone. These causal progressions in Benin, Madagascar, and Sierra Leone can be explained by the heightened levels of financial and investment globalisations present in these nations facilitating growth in the long run [31], and the significantly high contribution made by foreign direct investments to maximise the production capacity in Botswana, Gabon and Morocco [32].

However, the growth-economic globalisation nexus has emerged as statistically insignificant in Algeria, Congo, Rep., Lesotho, Niger, Tunisia, Zambia and Ghana. This implies that neither does economic integration influence growth in these nations, and nor does growth reinforce economic integration in these economies. Niger documenting the lowest levels of average economic integration, the disadvantages brought by natural resource dependency on Congo, Rep., Lesotho, Zambia and Ghana [83], the political instability in Algeria, and the political and financial crises situations faced by Tunisia [84], thus inhibiting their economic output and weakening the influence of globalisation can be identified as plausible reasons for the observed lack of causal connections.

Comparison with the existing scholarly discussions have resulted in both consistent and contradictory findings. Both financial and trade globalisation were found to exert a significantly optimistic impact on the economic progress in Burkina Faso, though evidence for the reciprocal causal connection for the country is absent. However, the causal flows observed from economic integration to growth from the study aligns with existing literature. Converse to the results observed in the study, literature has identified economic globalisation to cause growth in Eswatini and Rwanda, exert a negative impact on the Mali's economic growth, while positively affecting the long-term growth and negatively affecting the short-term growth in Egypt. Furthermore, economic integration is found influencing growth in Algeria, Congo, Rep., Lesotho, Niger, Tunisia, Zambia [12,23,26,27] and vice-versa in Ghana [20].

A bidirectional causal progression was revealed in Algeria between

social globalisation and growth. Information and communication technology infrastructure in Algeria has achieved a notable growth towards the recent years, while also assisting economic (exports) diversification. Furthermore, this economy is dominated by the telecommunication and information technology sector [85], thereby strengthening cultural and informational globalisation through the avenues to exchange knowledge, cultures, and information. These observations can be cited as likely explanations for the mutually reinforcing interlink between social integration and economic progress.

Burkina Faso, Burundi, Gabon, Ghana, Kenya and Uganda depict a relationship where growth is caused by social integration. Interpersonal globalisation resulted through the migration of labour from Burkina Faso, Burundi, Kenya and Uganda thus resulting in remittance capital to fuel growth initiatives of the nations [86–89], the negative influence observed on the economic progress of Gabon through mixed migration capable of creating economic and political instabilities in the country [90], along with the extensive digital connectivity in Ghana to facilitate economic development in the country through the strengthening of literacy [91] are probable causes for the observed social globalisation led macroeconomic progress.

On the contrary, economic growth was identified exerting a unidirectional causal impact on social integration in Congo Republic, Morocco, Niger, Rwanda, Sierra Leone, Tunisia and Zambia. The exports of oil by Congo Republic and Uranium by Niger which drives its economic growth thus facilitating its global ties [92,93], social integration fuelled by tourism led growth in Morocco and Tunisia [94,95], and human capital development accomplished by Rwanda and Sierra Leone through structural reforms pertaining to education thus opening doors for global educational opportunities through interpersonal globalisation, [96,97] substantiates the growth driven social integration in these economies.

The social globalisation-economic growth nexus in Benin, Botswana, Cameroon, Cote De Ivoire, Egypt, Eswatini, Madagascar, Mali, Mauritania, and Seychelles turned out to be statistically insignificant. Insufficient access to international connectivity by Mauritania and Mauritania [98,99], recording of low degrees of social globalisation by Benin, Cote De Ivoire, and Mali, resistance to cultural globalisation by Egypt [100], and Eswatini can be identified as factors leading to the such observations.

When compared with the findings of existing literature related to the field, causal progressions in Burundi aligns previous studies where social globalisation is identified impacting growth negatively [27]. Furthermore, social integration is found promoting growth in Gabon, Ghana, Kenya, and Uganda through maximising female economic participation [13]. Unidirectional findings observed in this study about the Congo Republic, Niger, Rwanda, Sierra Leone and Zambia contradicts what has been substantiated in previous studies [35], where causality has flown from social globalisation towards growth. Additionally, statistically significant associations between social integration and growth were found in Benin, Botswana, Cameroon, Madagascar, Mali, Mauritania, and Seychelles [13,27].

A unilateral relationship from political integration to economic growth in Mauritania, Rwanda and Ghana. The findings of this study are consistent with the existing literature in the context of Mauritania and Ghana where political governance proxied for political integration exerts a significant impact on economic expansion [10]. All these nations are a part of the AU, a study focused on the integration of the macro-economic dynamics in the AU reveals that the nations which integrate rapidly in the AU tends to have a low growth in the GDP within the nations [101]. However, the findings of this study reveal that Rwanda and Ghana showing high levels of integration in the AU as active members, generate considerably high economic growth statistics. Furthermore, unidirectional causal progressions were discovered from economic growth to political integration in Cameroon, Cote De Ivoire, Kenya, and Lesotho.

Moreover, no statistically significant causal relationships were

revealed between political globalisation and economic growth in Algeria, Benin, Botswana, Burkina Faso, Burundi, Congo Republic, Egypt, Eswatini, Gabon, Madagascar, Mali, Morocco, Niger, Seychelles, Sierra Leone, Tunisia, Uganda and Zambia. Furthermore, the associations and interrelations between DGDP and all the globalisation variables (DGLO, DEGLO, DSGLO, and DPGLO) materialised as statistically insignificant in the Central African Republic, Chad, Gambia, Nigeria, Senegal, South Africa, Sudan, and Togo. However, these findings contradict with existing literature which have discovered relationships between the variables corresponding to the nations which does not display any causal flows in this study [10,12,27,29]. The differences of the periods analysed and the difference of the way of analysis; only the nations belonging to the African region being examined in the current study, while a majority of the identified previous literature had examined the selected African nations in a global context can be identified as possible reasons for the contradictions between the results obtained in this and the previous studies.

The outcomes of the Granger Causality analysis have been summarised in the Fig. 7.

Following the cross-country Granger Causality analysis, the identified casualties were tested for consistency by conducting robustness checks, for which the results are presented in the Appendix E. Accordingly, it was observed as to how majority of the identified causalities have turned out to be the same during the robustness check, thus substantiating the reliability of the findings.

4.2. Regional analysis

4.2.1. Wavelet Coherence analysis

By considering the first variable as GDP, and the facets of globalisation (GLO, EGLO, SGLO and PGLO) as the second variables during the analysis, Wavelet Coherence graphs have been generated for the whole of the African region. While the area bordered by the grey-shaped cone is identified as the 'area of influence' utilised for the analysis, the 5% significance level is characterised by the black line, which in turn is decided according to the Monte Carlo Simulations. While the areas in the graph pigmented in red signify the presence of correlation, the areas coloured in blue represent the absence of correlation [102]. Furthermore, based on the scale ranging from 0 to 256, the scopes between 0 to 16, 16 to 64, and 64 to 256 is identified as the short, medium, and long terms, respectively in this study.

Demonstrated in the Table 2 are certain additional attributes necessary in the interpretation and the comprehension of the illustrated Wavelet Coherence graphs.

The relationship between GLO and GDP in the African region during the period from 1971 to 2021 based on the Wavelet Analysis is shown in Fig. 8. In the short term, a positive bi-directional relationship between the variables can be witnessed in the periods from 1971 to 2001. However, during the subsequent two periods (2001 to 2011 and 2011 to 2021), while the bi-directional interrelation between the variables had persisted, the nature of the correlation has taken the form of a mixture of both positive and negative. It is noted as to how these interrelations in the short term had occurred at a high frequency. These mixed variations have taken place as a result of the disintegrational negative impacts of the global financial crisis during 2007-2009 period and the positive impacts gained from the credit reforms by International Monetary Fund targeting the Sub-Saharan Africa as a recovery measure for the crisis [103]. In the medium term, while a positive correlation has persisted, two-way causal progressions are detected during 1971 to 1981 and 2001 to 2011 at a medium frequency and from 1991 to 2001 and 2011 to 2021 at a high frequency. However, between 1981 and 1991 a unidirectional causal flow where the GDP had caused GLO at a medium frequency is also noticeable. While the first three periods, in the long run, depict the absence of any causal connections between the variables, the latter two periods represent the presence of positive unidirectional causal flows from GDP to GLO at a medium frequency. Africa is home to some of the

world's most grieving economies, contributing many nations to the low-income economic category. Specifically, Sub-Saharan Africa is found to have a deceleration in provisions made for health and education sectors of the region. However, these African regions are said to have a competitive advantage in terms of natural resources [8] bringing in opportunities for the transfer of trade benefits, culture and technology and international relations. This phenomenon has broadened its reach to the global markets, resulting in overall globalisation and economic growth to have a tighter relationship towards the recent 20 years in all three terms, going by the findings of this study.

The nature of the relationship, as depicted by Fig. 9 between growth and globalisation has taken the form of a majorly mixed correlation in the short run. The varying short-term effects exerted by changes in commodity and investment markets [8], and due to numerous structural adjustment programs basing Africa [104], can be identified as possible reasons for this observation. However, this mixed correlation effect has transformed to being majorly positive in both medium and long terms. The economic advantages brought about by policy developments and the increased consolidation of African nations to the global economic system which occurs through time may have been responsible for this optimistic transformation. A study conducted to assess the nexus between energy transformation, technology, growth and economic globalisation in the North African region has found the interrelation between financial globalisation and development in the long run to take a positive form [26]. Bidirectional causalities can be detected between 1981 and 2011 at a high frequency in the short run, and between 1991 and 2021 in the medium term. A study that analysed the association between financial globalisation and environmental sustainability in the Western African segment confirms a two-way relationship between the former and economic growth between the period 1990 and 2019 [28]. Unidirectional causal progression from growth to economic integration can be detected between 1971 to 1981 and 2001 to 2021 in the short run, 1971 to 1981 in the medium term and from 1991 to 2021 in the long run. A study basing Ghana recognises a causal flow from economic growth towards economic globalisation using the Wavelet Coherence methodology [20], thus substantiating this observed causal relation.

The interrelation between social globalisation and growth from 1971 to 2021 within the African region is visualised in Fig. 10. Two-way causal flows are observable throughout the short and medium terms. The nature of the correlation during these durations have taken the forms of both positive and mixed correlation, potentially fuelled by inconsistent and disproportionate effects of social challenges brought by political instabilities, weak social infrastructure possessed by African nations, and social crises such as COVID-19 pandemic. In the long term, economic growth has led social integration with a positive correlation and at a high frequency between 1981 and 2021. The capability portrayed by the African nations in reinforcing their socioeconomic structures, the increased investments they have made in developing their human resources and expanding their social networks, while making their way through the social shifts overtime can be identified as potential reasons for the positive correlation in the long-term. This finding aligns with previous literature where social globalisation is determined to be positively correlated and stimulating growth in Africa by elevating and augmenting the production capabilities and the quality of the goods being produced [9]. Furthermore, informational globalisation is also found driving the improvement of the social standing of females [13]. However, certain studies also regard social integration to be negatively correlated with growth, especially in the low-income African Africa [27]. The limited access and usage of internet due to the digital access gap and due to the internet not being structured to be advantageous to the production frameworks of certain nations in Africa [9], social globalisation is also found hampering the growth of these regions.

Fig. 11 delineates the relationships between PGLO and GDP in the African region. Positive correlation was discovered in the periods 1971-1981 and 2001-2011, and mixed effects in the periods 1981-1991, 1991-2001 and 2011-2021 in the short-term. Bi-directional relationships were

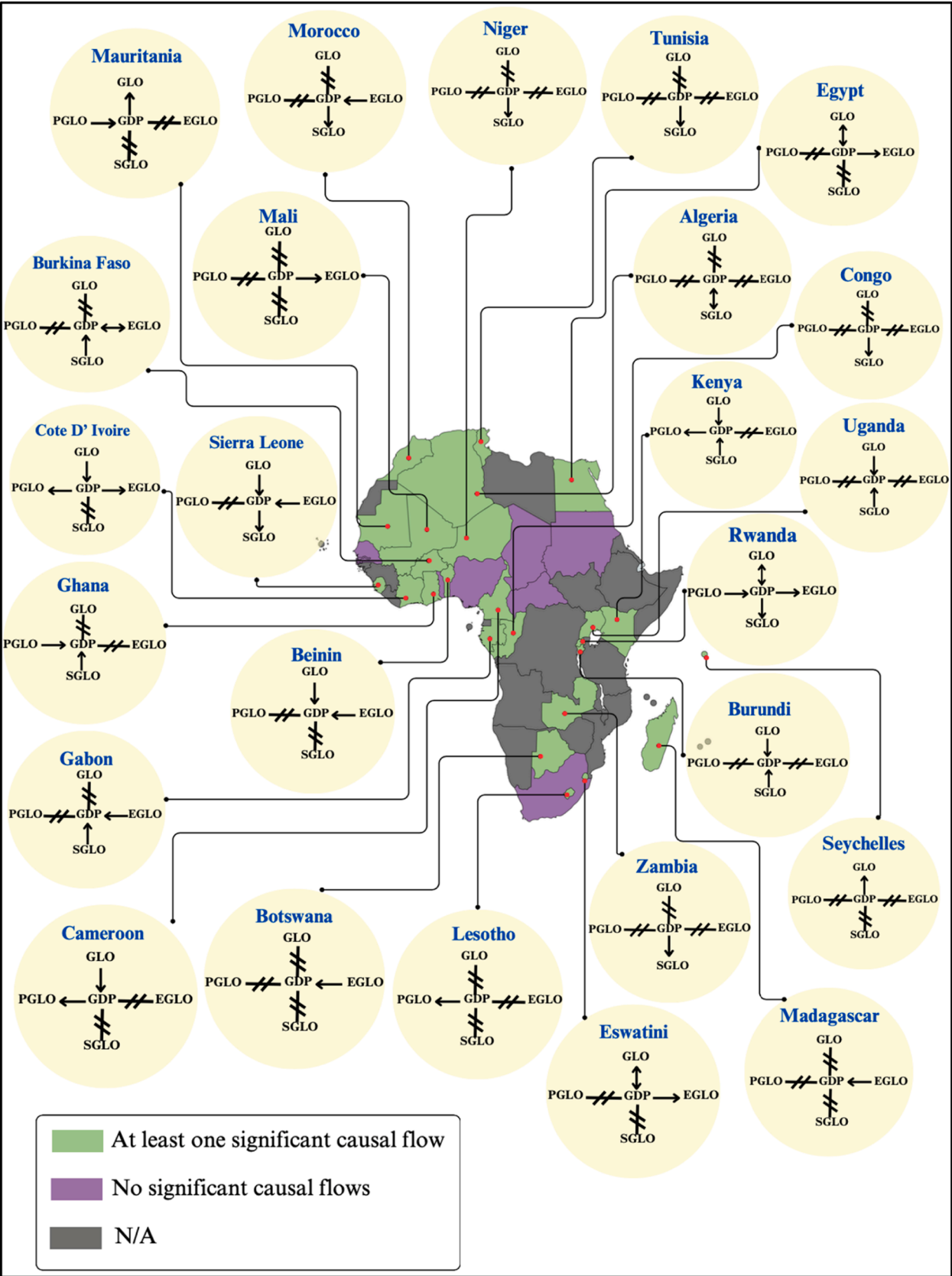


Fig. 7. Summary of cross-country granger results.
Source: Authors' illustration.

Table 2
Interpretation of Wavelet Coherence.

Symbol	Description	
→	Rightward Arrow	In-phase (Positive Correlation)
←	Leftward Arrow	Anti-phase (Negative Correlation)
↗	Rightward Up Arrow	The second variable (GLO, EGLO, SGLO, PGLO) causing the first variable (GDP).
↘	Rightward Down Arrow	The first variable (GDP) causing the second variable (GLO, EGLO, SGLO, PGLO).
↔ and ↔	Both rightward up and rightward down arrows	Bidirectional casual flow between the first variable (GDP) and the second variable (GLO, EGLO, SGLO, PGLO).
↖	Leftward Up Arrow	The second variable (GLO, EGLO, SGLO, PGLO) causing the first variable (GDP).
↙	Leftward Down Arrow	The first variable (GDP) causing the second variable (GLO, EGLO, SGLO, PGLO).
↔ and ↔	Both leftward up and leftward down arrows	Bidirectional casual flow between the first variable (GDP) and the second variable (GLO, EGLO, SGLO, PGLO).

Source: Authors' compilation.

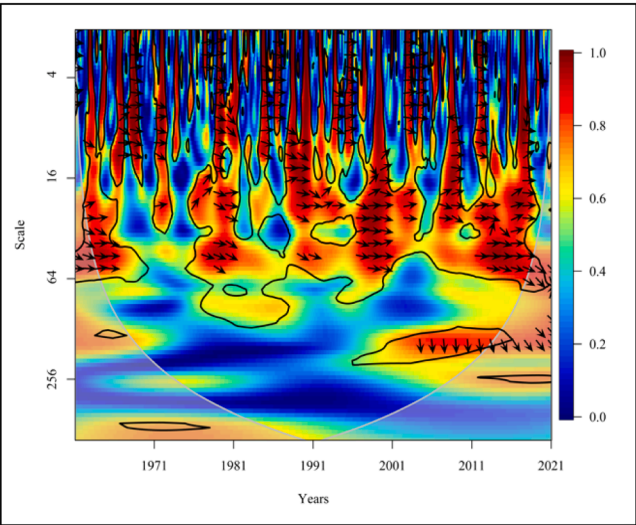


Fig. 8. Wavelet Coherence diagram: GLO.
Source: Authors' illustration.

discovered with high frequency in periods 1971-1981, 1981-1991, 1991-2001 and 2011-2021, whereas GDP causes PGLO with positive correlation during the period 2001-2011 in the short-term. PGLO and GDP tend to have a positive bi-directional relationship at all periods in the medium term. However, the frequencies at a 5% significance level in the periods 1971-1981, 1981-1991 and 2011-2021 are positive but comparatively medium-scaled. In the long-term, GDP tends to hurt PGLO with a medium correlation during the period 1971-1981. However, there are no long-term relationships during the rest of the four periods. The existence of positive growth effects from the political dimension of globalisation can be reasoned out by the numerous engagements of the African nations in many international treaties and its memberships with international organisations [27]. Furthermore, standalone nations like Nigeria, South Africa, and Egypt can be considered as potential nations with rapid growth effects classified under BRICS, MINT and MENA respectively contributing the globalisation dynamics. Hence, the nexus between political globalisation and

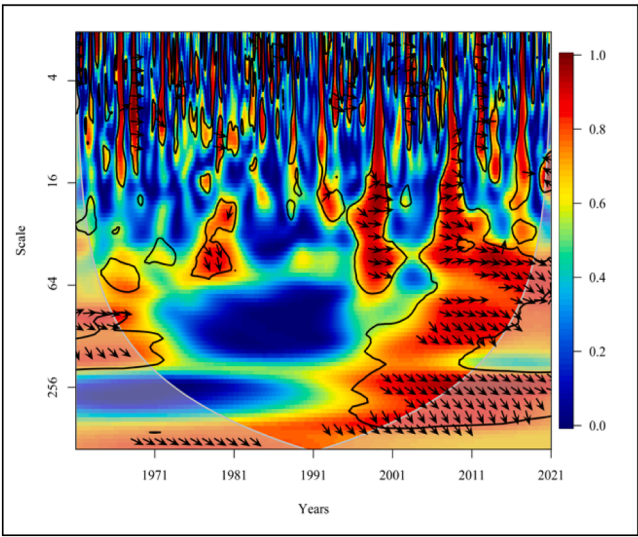


Fig. 9. Wavelet Coherence diagram: EGLO.
Source: Authors' illustration.

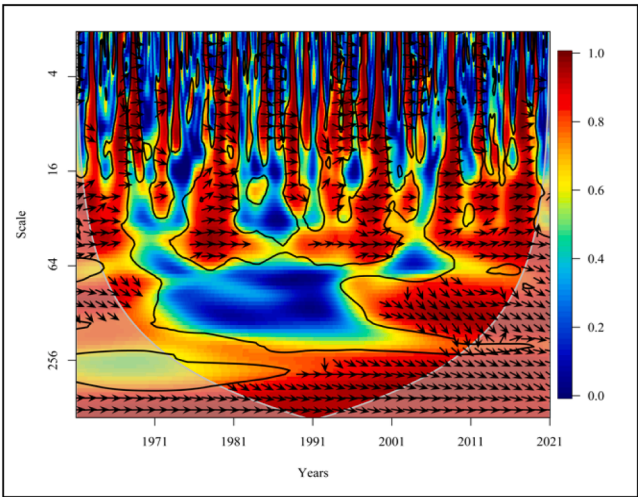


Fig. 10. Wavelet Coherence diagram: SGLO.
Source: Authors' illustration.

economic progression in short and medium terms with positive effects could be explained with reference to the findings of this study.

The above interpretations pertaining to the correlation and causal effects within the African region with respect to the identified time periods have been condensed in the Fig. 12.

5. Conclusion

This study was conducted to examine causal relationships between economic growth and globalisation in the African region by deploying Wavelet Coherence at a regional level and Granger Causality test at a cross-country level utilising a dataset of 33 African nations over a period of 51 years (1971-2021). African region is home to a large number of developing and least developed nations. Hence, poverty, hunger, poor governance and inequalities have been strongly penetrated into their lifestyles. The findings of this study delineate how most of the nations could benefit from globalisation and its 3 dimensions. Thriving nations like Rwanda and Egypt showing bilateral causalities could aid the underperforming nations in the region to achieve sustainable development by 2030 and eradicating poverty, hunger, and inequalities.

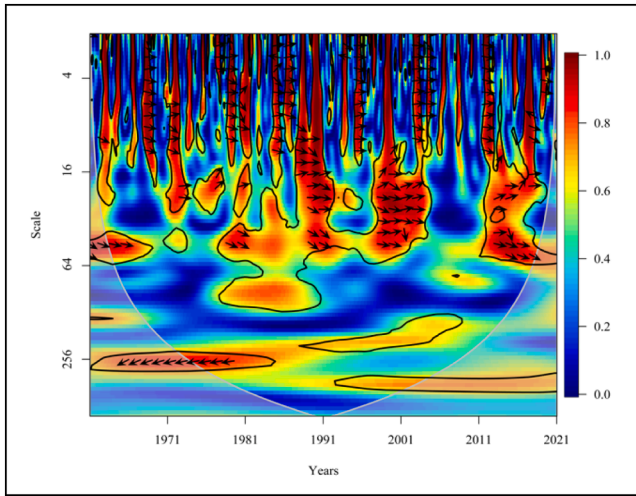


Fig. 11. Wavelet Coherence diagram: PGLO.
Source: Authors' illustration.

Accordingly, 25 nations out of the evaluated 33, present a causal relationship between the variables, hence providing the region with a considerable opportunity in attaining sustainable development in the domain of globalisation in-line with UN SDGs and AU Agenda of 2063. Specifically, underperforming economies like Burundi and Madagascar benefiting from globalisation and economic integration respectively, could eradicate poverty and corruption by utilising the opportunities of global integration. Hence, trade liberalisation and improving institutional quality of such nations would positively impact the sustainable economic expansion.

In the context of the entire African region, globalisation and economic growth mutually impact each other in the short run. Hence, initiatives taken towards integrating across other world regions will positively expand the economies within the African region. Drafting socio-economic and political policies to support Africa in-line SDGs pronounced by the UN and the goals identified in the AU Agenda of 2063 would result in prosperous outcomes for the region.

6. Policy recommendations

The findings of this study provide diverse causalities between the variables confined to standalone nations and the entirety of the African region in general. The policies have been recommended in-line with the

Time range	Short term				Medium term				Long term			
	GDP GLO	GDP EGLO	GDP SGLO	GDP PGLO	GDP GLO	GDP EGLO	GDP SGLO	GDP PGLO	GDP GLO	GDP EGLO	GDP SGLO	GDP PGLO
1971 – 1981												
1981 – 1991												
1991 – 2001												
2001 – 2011												
2011 – 2021												

Source: Authors' compilation.

Note:

1. Nature of the correlation

- Positive - Negative - Mixed

2. Direction of the arrows

, -First variable causing the second variable
 , -Second variable causing the first variable
 -Bidirectional causal progression

3. Scale of frequency

-High -Medium

-No causality

Fig. 12. Wavelet Coherence analysis summary.
Source: Authors' compilation.

prospective of achieving the Sustainability Development Goals listed by the United Nations and the goals of Agenda 2063: The Africa We Want formulated by the AU.

Rwanda, Eswatini and Egypt, delineates two-way causal relationships between globalisation and growth. In that endeavour, assisting small scale industries and offering manageable credit to developing neighbour countries would provide them access to global markets and value chains. Such efforts will support in achieving the targets attached to SDG 9: Industry, Innovation and Infrastructure prioritising the development aspects of underperforming economies. With the aim of achieving SDG 17: Partnerships for the Goals and the AU agenda of 2063, enhancing financial flows of the developing nations, sustainable debt management with favourable debt relief opportunities could be recommended.

Furthermore, nations like Ghana, Rwanda, and Sierra Leone which have comparatively high rates of economic integration, should promote regional cooperation by actively engaging more within the AU and other sub-regional associations. Such efforts would contribute to the social and economic facets of integration, reinforcing national and regional alliances, to ultimately result in the construction of sustainable cities and communities with resilience and accordingly accomplish the targets of SDG 11 and multiple priority areas in the AU agenda of 2063.

Egypt, that focuses more on human capital should invest in education and skill development in the country. Hence, conducting skill development training programs would improve the quality of life. These actions conform to the objectives of the SDG 4: Quality Education, which will lead to the facilitation of comprehensive and perpetual educational avenues of quality to its citizens. Improving skills in Science, Technology and Innovation (STI) is a major priority area in the AU agenda of 2063. Such development frameworks would increase the productivity of the labour force while providing a competitive edge to the country.

Nations like Burundi, Chad and Madagascar, which tend to underperform in the region, should focus more on improving the institutional quality. They should sustainably ensure transparency, accountability, and formation of stable and impartial governance structures. Simultaneously, they should encourage equal participation in decision making and global governance in the journey towards achieving SDG 16: Peace, Justice and Strong Institutions and the AU agenda of 2063. Furthermore, they should clear out any unfavourable restrictions in entering the global markets with duty free and quota free accessibility. The policies customised to support such underperforming economies should affirm economic resilience with the capability of withstanding to economic turbulences in line with SDG 10: Reduced Inequalities.

Nations which are dense in natural resources, like Nigeria and Gabon, should invest more effort in capitalising natural wealth factors with the long-term purpose of sustainable growth. Emerging industries which directly utilise the natural resources of such nations have a comparative advantage, opening new avenues for international trade and investments. Hence, by 2030, the prospective of achieving sustainability through efficient utilisation of natural resources going by the SDG 12: Responsible Consumption and Production could be enhanced. Revenues generated from natural resources-based trade efforts, should be re-invested in education, and healthcare with an equitable share to strengthen the socio-economic sphere in achieving targets of SDG 15: Life on Land and the AU agenda of 2063 in environmental sustainability.

An observable lack of political integration was noticed in the nations Tunisia, Uganda and Zambia with statistically insignificant causal flows. Promoting international coherence and facilitating harmonic participation in global agreements and pacts would bolster political integration, leading to economic expansion simultaneously. These efforts in establishing political partnerships will also aid in the assurance of macroeconomic stability, sustainable development, and poverty alleviation in-line with SDG 17: Partnerships for Goals.

With the mixed findings of the nexus between globalisation and economic growth, it is essential for all nations in the African region to adapt to shockproof economic structures. Affirming endurance during

uncertainties like politically unstable situations and trade disruptions is essential due to the high economic volatility of the African nations. Hence, it is essential to diversify economies, enhance domestic resource mobility and invest more on research and development to mitigate potential risks and shocks going by the perspectives of AU agenda of 2063. Such efforts will also ensure the realisation SDG 9: Industry, Innovation, and Infrastructure.

7. Limitations

The Wavelet Coherence methodology is sensitive to sample size, which may result in certain long- and short-term movements not being fully captured. Additionally, the visual representation of Wavelet plots can be complex, increasing the potential for misinterpretation of time-frequency results. Furthermore, the Morlet Wavelet Coherence methodology is not applicable to cross-sectional analyses. To overcome these identified methodological gaps, further research can apply innovative approaches such as Time-varying Vector Autoregressive (VAR) and Machine Learning models in their analysis.

Moreover, while this study employs a bivariate Granger Causality framework to isolate the direct causal relationship between globalisation and economic growth, we acknowledge the potential for omitted variable bias due to the absence of additional macroeconomic control variables. Although the Wavelet Coherence methodology helps mitigate this concern by capturing time-varying interactions, future research could enhance robustness by incorporating a multivariate Granger framework, controlling for key economic factors such as trade openness, foreign direct investment, and institutional quality.

There are also potential limitations concerning the quality of the data collected, particularly in the earlier years of the study (1971–2021), as measurement techniques and data collection methodologies have evolved over time. Earlier data may be less robust compared to more recent records, potentially affecting consistency. Despite these limitations, this study provides a rigorous empirical investigation into the globalisation-growth nexus, offering valuable insights while laying the foundation for further exploration using alternative econometric approaches.

Supporting information

- Appendix A: Data File
- Appendix B: Cross Country Summary Statistics
- Appendix C: Stationarity Results
- Appendix D: Granger Causality Results
- Appendix E: Results of The Robustness Check

CRedit authorship contribution statement

Piyara Wijesuriya: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Dinithi Athalage:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Data curation, Conceptualization. **Danushi Rathnayake:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Irushu Sandanayaka:** Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Data curation, Conceptualization. **Ruwan Jayathilaka:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Conceptualization, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.sfr.2025.100833](https://doi.org/10.1016/j.sfr.2025.100833).

Data availability

All data generated or analysed during this study is available as a supplementary information file.

References

- [1] A. Dreher, Does globalization affect growth? Evidence from a new index of globalization, *Appl. Econ.* 38 (2006) 1091–1110, <https://doi.org/10.1080/00036840500392078>.
- [2] R.J. Barro, Economic growth in a cross section of countries, *Q. J. Econ.* 106 (2) (1991) 407–443, <https://doi.org/10.2307/2937943>.
- [3] N.G. Mankiw, D. Romer, D.N. Weil, A contribution to the empirics of economic growth, *Q. J. Econ.* 107 (2) (1992) 407–437, <https://doi.org/10.2307/2118477>.
- [4] R.M. Solow, A contribution to the theory of economic growth, *Q. J. Econ.* 70 (1) (1956) 65–94, <https://doi.org/10.2307/1884513>.
- [5] M. Abubakar, Globalisation and output growth nexus in Sub-Saharan Africa: the critical role of trade liberalisation, *J. Knowl. Econ.* 15 (1) (2024) 2218–2240, <https://doi.org/10.1007/s13132-023-01230-y>.
- [6] Ehigiamusoe, K. U. (2023). A disaggregated approach to analysing the effects of globalization and energy consumption on economic growth: new insights from low-income countries. 28(4), 3976–3996. [doi:10.1002/ijfe.2631](https://doi.org/10.1002/ijfe.2631).
- [7] A. Aslan, B. Altinoz, The impact of natural resources and gross capital formation on economic growth in the context of globalization: evidence from developing countries on the continent of Europe, Asia, Africa, and America, *Environ. Sci. Pollut. Res.* 28 (26) (2021) 33794–33805, <https://doi.org/10.1007/s11356-021-12979-7>.
- [8] M.S. Glennice Fosah, N. Mama, G. Dohba Dinga, T.N. Nchofoung, The effect of globalisation on Sub-Saharan Africa's development thrives, *Res. Glob.* 7 (2023) 1–8, <https://doi.org/10.1016/j.resglo.2023.100149>.
- [9] Nguea, S. M., Fotio, H. K., & Baida, L. A. (2022). Investigating the effects of globalization on economic sophistication in selected African countries. 34(3), 324–338. [doi:10.1111/1467-8268.12666](https://doi.org/10.1111/1467-8268.12666).
- [10] W.O. Shittu, H.A. Yusuf, A. El Moutar El Houssein, S. Hassan, The impacts of foreign direct investment and globalisation on economic growth in West Africa: examining the role of political governance, *J. Econ. Stud.* 47 (7) (2020) 1733–1755, <https://doi.org/10.1108/JES-09-2019-0446>.
- [11] G. Tariq, H. Sun, U. Fernandez-Gamiz, S. Mansoor, A.A. Pasha, S. Ali, M.S. Khan, Effects of globalization, foreign direct investment and economic growth on renewable electricity consumption, *Heliyon* 9 (2023), <https://doi.org/10.1016/j.heliyon.2023.e14635>, 1–14.
- [12] P. Zahonogo, Globalization and economic growth in developing countries: evidence from Sub-Saharan Africa, *Int. Trade J.* 32 (2018) 189–208, <https://doi.org/10.1080/08853908.2017.1333933>.
- [13] S.A. Asongu, U.R. Efofi, B.V. Tanankem, E.S. Osabuohien, Globalisation and female economic participation in Sub-Saharan Africa, *Gender Issues* 37 (1) (2020) 61–89, <https://doi.org/10.1007/s12147-019-09233-3>.
- [14] M.T.I. Khan, S. Anwar, S.A. Sarkodie, M.R. Yaseen, A.M. Nadeem, Do natural disasters affect economic growth? The role of human capital, foreign direct investment, and infrastructure dynamics, *Heliyon* 9 (2023), <https://doi.org/10.1016/j.heliyon.2023.e12911>, 1–19.
- [15] I. Uddin, M. Azam Khan, Global evidence on the impact of globalization, governance, and financial development on economic growth, *J. Knowl. Econ.* (2023) 1–32, <https://doi.org/10.1007/s13132-023-01656-4>.
- [16] X. Guo, X. Meng, Q. Luan, Y. Wang, Trade openness, globalization, and natural resources management: the moderating role of economic complexity in newly industrialized countries, *Resour. Policy* 85 (2023) 1–10, <https://doi.org/10.1016/j.resourpol.2023.103757>.
- [17] I. Juan, Y. Shen, X. Li, A. Hasnaoui, BRICS carbon neutrality target: measuring the impact of electricity production from renewable energy sources and globalization, *J. Environ. Manag.* 298 (2021) 1–10, <https://doi.org/10.1016/j.jenvman.2021.113460>.
- [18] I.M. Muye, I.Y. Muye, Testing for causality among globalization, institution and financial development: further evidence from three economic blocs, *Borsa Istanbul. Rev.* 17 (2017) 117–132, <https://doi.org/10.1016/j.bir.2016.10.001>.
- [19] Dabwor, D. T., Iorember, P. T., & Yusuf Danjuma, S. (2022). Stock market returns, globalization and economic growth in Nigeria: evidence from volatility and cointegrating analyses. 22(2), 1–12. [doi:10.1002/pa.2393](https://doi.org/10.1002/pa.2393).
- [20] S.T. Baidoo, B. Tetteh, E. Boateng, R.E. Ayibor, Estimating the impact of economic globalization on economic growth of Ghana: Wavelet Coherence and ARDL analysis, *Res. Glob.* 7 (2023) 1–14, <https://doi.org/10.1016/j.resglo.2023.100183>.
- [21] Z. Latif, Y. mengke, Danish, S. Latif, L. Ximei, Z.H. Pathan, Z. Jianqiu, The dynamics of ICT, foreign direct investment, globalization and economic growth: panel estimation robust to heterogeneity and cross-sectional dependence, *Telemat. Inform.* 35 (2018) 318–328, <https://doi.org/10.1016/j.tele.2017.12.006>.
- [22] K. Fachrurrozi, R. Masbar, Aliasuddin, C. Seftarita, Energy-growth-globalization (EGG) nexus in N-11 countries, *Heliyon* 8 (2022), <https://doi.org/10.1016/j.heliyon.2022.e10522>, 1–9.
- [23] S.M. Nguea, A.G. Noulia, I. Noulia, Financial globalization and democracy: implications for economic growth in African countries, *J. Knowl. Econ.* 15 (1) (2024) 3355–3379, <https://doi.org/10.1007/s13132-023-01311-y>.
- [24] T. Sunde, Foreign direct investment, exports and economic growth: ADRL and causality analysis for South Africa, *Res. Int. Bus. Financ.* 41 (2017) 434–444, <https://doi.org/10.1016/j.ribaf.2017.04.035>.
- [25] L.A. Olorogun, Modelling financial development in the private sector, FDI, and sustainable economic growth in sub-Saharan Africa: ARDL bound test-FMOLS, DOLS robust analysis, *J. Knowl. Econ.* 15 (2) (2024) 8416–8434, <https://doi.org/10.1007/s13132-023-01224-w>.
- [26] M. Alariqi, W. Long, P.R. Singh, A. Al-Barakani, A. Muazu, Modelling dynamic links among energy transition, technological level and economic development from the perspective of economic globalisation: evidence from MENA economies, *Energy Rep.* 9 (2023) 3920–3931, <https://doi.org/10.1016/j.egy.2023.02.089>.
- [27] B.B. Rao, K.C. Vadlamannati, Globalization and growth in the low income African countries with the extreme bounds analysis, *Econ. Model.* 28 (2011) 795–805, <https://doi.org/10.1016/j.econmod.2010.10.009>.
- [28] M. Musah, S. Taiwo Onifade, E. Satrovic, J. Akwasi Nkyi, Assessing the palliative aspects of green innovations in the non-linear tendencies of environmental sustainability-financial globalization nexus among West African states, *Geosci. Front.* 15 (2024) 1–22, <https://doi.org/10.1016/j.gsf.2024.101893>.
- [29] S.K. Coulbaly, C. Erbao, T. Metuge Mekongcho, Economic globalization, entrepreneurship, and development, *Technol. Forecast. Soc. Chang.* 127 (2018) 271–280, <https://doi.org/10.1016/j.techfore.2017.09.028>.
- [30] B. Gaies, S. Goutte, K. Guesmi, What interrelations between financial globalization and instability?—Growth in developing countries, *J. Int. Dev.* 31 (1) (2019) 39–79, <https://doi.org/10.1002/jid.3391>.
- [31] B. Gaies, S. Goutte, K. Guesmi, Does financial globalization still spur growth in emerging and developing countries? Considering exchange rates, *Res. Int. Bus. Financ.* 52 (2020) 1–19, <https://doi.org/10.1016/j.ribaf.2019.101113>.
- [32] D. Gomes Neto, F.J. Veiga, Financial globalization, convergence and growth: the role of foreign direct investment, *J. Int. Money Financ.* 37 (2013) 161–186, <https://doi.org/10.1016/j.jimonfin.2013.04.005>.
- [33] M. Kandil, M. Shahbaz, S. Nasreen, The interaction between globalization and financial development: new evidence from panel cointegration and causality analysis, *Empir. Econ.* 49 (2015) 1317–1339, <https://doi.org/10.1007/s00181-015-0922-2>.
- [34] A.O. Acheampong, E. Boateng, M. Amponsah, J. Dzator, Revisiting the economic growth–energy consumption nexus: does globalization matter? *Energy Econ.* 102 (2021) 1–18, <https://doi.org/10.1016/j.eneco.2021.105472>.
- [35] N.A.S. Burhan, A.H. Sidek, Y. Kurniawan, M.R. Mohamad, Has globalization triggered collective impact of national intelligence on economic growth? *Intelligence* 48 (2015) 152–161, <https://doi.org/10.1016/j.intell.2014.11.003>.
- [36] A. Ghosh, How does banking sector globalization affect economic growth? *Int. Rev. Econ. Financ.* 48 (2017) 83–97, <https://doi.org/10.1016/j.iref.2016.11.011>.
- [37] M. Du, C. Huang, L. Liao, Trade liberalization and energy efficiency: quasi-natural experiment evidence from the pilot free trade zones in China, *Econ. Anal. Policy* 85 (2025) 1739–1751, <https://doi.org/10.1016/j.eap.2025.02.019>.
- [38] Huang, J., Sun, Z., & Du, M. (2022). Differences and drivers of urban resilience in eight major urban agglomerations: evidence from China. 11(9), 1–18. [doi:10.3390/land11091470](https://doi.org/10.3390/land11091470).
- [39] S. Iamsiraroj, The foreign direct investment–economic growth nexus, *Int. Rev. Econ. Financ.* 42 (2016) 116–133, <https://doi.org/10.1016/j.iref.2015.10.044>.
- [40] P.M. Romer, The origins of endogenous growth, *J. Econ. Perspect.* 8 (1) (1994) 3–22, <https://doi.org/10.1257/jep.8.1.3>.
- [41] H. Bloch, D. Sapsford, Prebisch and singer effects on the terms of trade between primary producers and manufacturers, in: D. Sapsford, J.R. Chen (Eds.), *Proceedings of the Development Economics and Policy: The Conference Volume to Celebrate the 85th Birthday of Professor Sir Hans Singer*, London: Palgrave Macmillan UK, 1998, pp. 35–62.
- [42] W. Shrum, Science and development, in: N.J. Smelser, P.B. Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences*, Pergamon, Oxford, 2001, pp. 13607–13610.
- [43] C.W.J. Granger, Investigating causal relations by econometric models and cross-spectral methods, *Econometrica* 37 (1969) 424–438, <https://doi.org/10.2307/1912791>.
- [44] S.S. Akadiri, A.A. Alola, A.C. Akadiri, The role of globalization, real income, tourism in environmental sustainability target. Evidence from Turkey, *Sci. Total Environ.* 687 (2019) 423–432, <https://doi.org/10.1016/j.scitotenv.2019.06.139>.
- [45] S.P. Nathaniel, Z. Ahmed, Z. Shamansurova, H.A. Fakher, Linking clean energy consumption, globalization, and financial development to the ecological footprint in a developing country: insights from the novel dynamic ARDL simulation techniques, *Heliyon* 10 (5) (2024), <https://doi.org/10.1016/j.heliyon.2024.e27095>, 1–17.
- [46] M. Shahbaz, H. Mallick, M.K. Mahalik, S. Hammoudeh, Is globalization detrimental to financial development? Further evidence from a very large emerging economy with significant orientation towards policies, *Appl. Econ.* 50 (6) (2018) 574–595, <https://doi.org/10.1080/00036846.2017.1324615>.
- [47] C. Xie, X. Jin, The role of digitalization, sustainable environment, natural resources and political globalization towards economic well-being in China, Japan and South Korea, *Resour. Policy* 83 (2023) 1–11, <https://doi.org/10.1016/j.resourpol.2023.103682>.

- [48] Y. Cai, Y. Shen, G.S. Uddin, Financial conditions and Sino-US tensions: a Granger Causality analysis of diverging financial condition indicators, *Financ. Res. Lett.* 79 (2025) 1–6, <https://doi.org/10.1016/j.frl.2025.107199>.
- [49] A. Mayer, D. Wied, V. Troster, Quantile Granger Causality in the presence of instability, *J. Econom.* 249 (2025) 1–14, <https://doi.org/10.1016/j.jeconom.2025.105992>.
- [50] A. Raza, F. Alsulami, Positive and negative shocks of financial markets on sustainable finance in Europe: evidence from vector auto regression and Granger Causality, *Int. Rev. Econ. Financ.* 99 (2025) 1–19, <https://doi.org/10.1016/j.iref.2025.104042>.
- [51] D.A. Dickey, W.A. Fuller, Distribution of the estimators for autoregressive time series with a unit root, *J. Am. Stat. Assoc.* 74 (366a) (1979) 427–431, <https://doi.org/10.1080/01621459.1979.10482531>.
- [52] P. Atigala, T. Maduwanthi, V. Gunathilake, S. Satharani, R. Jayathilaka, Driving the pulse of the economy or the dilution effect: inflation impacting economic growth, *PLoS ONE* 17 (8) (2022) 1–17, <https://doi.org/10.1371/journal.pone.0273379>.
- [53] H. Akaike, Information theory and an extension of the maximum likelihood principle, in: E. Parzen, K. Tanabe, G. Kitagawa (Eds.), *Selected Papers of Hirotugu Akaike*, New York, NY: Springer New York, 1998, pp. 199–213.
- [54] G. Schwarz, Estimating the dimension of a model, *Ann. Stat.* 6 (2) (1978) 461–464, <https://doi.org/10.1214/aos/1176344136>.
- [55] Hannan, E. J., & Quinn, B. G. (1979). The determination of the order of an autoregression. 41(2), 190–195. [doi:10.1111/j.2517-6161.1979.tb01072.x](https://doi.org/10.1111/j.2517-6161.1979.tb01072.x).
- [56] T. Jayawardhana, R. Jayathilaka, S. Anuththara, T. Nimnadi, R. Karadanaarachchi, K. Galappaththi, Exploring the dynamics of the elderly population and economic growth: a comparative analysis across continents, *Soc. Indic. Res.* 173 (3) (2024) 543–568, <https://doi.org/10.1007/s11205-024-03353-4>.
- [57] L.C. Parra, A. Silvan, M. Nentwich, J. Madsen, V.E. Parra, B. Babadi, VARX Granger analysis: models for neuroscience, physiology, sociology and econometrics, *PLoS ONE* 20 (2025) 1–21, <https://doi.org/10.1371/journal.pone.0313875>.
- [58] C. Schmidt, B. Pester, N. Schmid-Hertel, H. Witte, A. Wismüller, L. Leistritz, A multivariate Granger Causality concept towards full brain functional connectivity, *PLoS ONE* 11 (2016) 1–25, <https://doi.org/10.1371/journal.pone.0153105>.
- [59] D. Palliyaguru, B. Senarathne, R. Jayathilaka, L. Rajamanthri, C. Wickramarachchi, Cheers to anxiety: Granger Causality insights on alcohol consumption patterns across 13 South American countries, *BMC Public Health* 24 (2024) 1–13, <https://doi.org/10.1186/s12889-024-20146-z>.
- [60] N. Perera, H. Disanayake, D. Samson, S. Abeykoon, R. Jayathilaka, M. Jayasinghe, S. Yapa, The interconnectedness of energy consumption with economic growth: a Granger Causality analysis, *Heliyon* 10 (2024), <https://doi.org/10.1016/j.heliyon.2024.e36709>, 1–18.
- [61] P. Goupillaud, A. Grossmann, J. Morlet, Cycle-octave and related transforms in seismic signal analysis, *Geophysics* 23 (1) (1984) 85–102, [https://doi.org/10.1016/0016-7142\(84\)90025-5](https://doi.org/10.1016/0016-7142(84)90025-5).
- [62] J.C. Onwe, M.G. Ojide, M. Subhan, D. Forgenie, Food security in Nigeria amidst globalization, economic expansion, and population growth: a Wavelet Coherence and QARDL analysis, *J. Agric. Food Res.* 18 (2024) 1–10, <https://doi.org/10.1016/j.jafr.2024.101413>.
- [63] D. Kirikkaleli, Analyses of Wavelet Coherence: financial risk and economic risk in China, *J. Financ. Econ. Policy* 13 (5) (2021) 587–599, <https://doi.org/10.1108/JFEP-08-2019-0174>.
- [64] S. Kuşkaya, N. Toğuş, F. Bilgili, Wavelet Coherence analysis and exchange rate movements, *Qual. Quant.* 56 (6) (2022) 4675–4692, <https://doi.org/10.1007/s11335-022-01327-7>.
- [65] F. Bilgili, İ. Öztürk, E. Koçak, Ü. Bulut, Y. Pamuk, E. Muğaloğlu, H.H. Bağlıtaş, The influence of biomass energy consumption on CO₂ emissions: a Wavelet Coherence approach, *Environ. Sci. Pollut. Res.* 23 (19) (2016) 19043–19061, <https://doi.org/10.1007/s11356-016-7094-2>.
- [66] Y. Caldera, T. Ranthilake, H. Gunawardana, D. Senevirathna, R. Jayathilaka, N. Rathnayake, S. Peter, Understanding the interplay of GDP, renewable, and non-renewable energy on carbon emissions: global Wavelet Coherence and Granger Causality analysis, *PLoS ONE* 19 (9) (2024) 1–31, <https://doi.org/10.1371/journal.pone.0308780>.
- [67] L. Zhang, Z. Li, D. Kirikkaleli, T.S. Adebayo, I. Adeshola, G.D. Akinsola, Modeling CO₂ emissions in Malaysia: an application of Maki cointegration and Wavelet Coherence tests, *Environ. Sci. Pollut. Res.* 28 (20) (2021) 26030–26044, <https://doi.org/10.1007/s11356-021-12430-x>.
- [68] P. Léné, A.J. Karran, E. Labonté-Lemoyne, S. Sénécal, M. Fredette, K.J. Johnson, P.M. Léger, Wavelet transform coherence: an innovative method to investigate social interaction in NeuroIS, in: *Proceedings of the Information Systems and Neuroscience*, Cham, 2020.
- [69] A. Rezaee, A. Mosaedi, A. Beheshti, A. Zarrin, Using wavelet transform to analyze the dynamics of climatic variables; to assess the status of available water resources in Iran (1961–2020), *Earth Sci. Inform.* (2024), <https://doi.org/10.1007/s12145-024-01433-0>.
- [70] A.H. Elsayed, G. Gozgor, R. Khalfaoui, N. Tarchella, Impact of supply chain pressure on traditional energy and metal markets: a wavelet-based quantile-on-quantile perspective, *J. Commod. Mark.* 38 (2025) 1–15, <https://doi.org/10.1016/j.jcomm.2025.100472>.
- [71] K. Galappaththi, R. Jayathilaka, L. Rajamanthri, T. Jayawardhana, S. Anuththara, T. Nimnadi, R. Karadanaarachchi, Economy and elderly population, complementary or contradictory: a cross-continental Wavelet Coherence and cross-country Granger Causality study, *PLoS ONE* 18 (1) (2023) 1–17, <https://doi.org/10.1371/journal.pone.0278716>.
- [72] C. Wijesekara, C. Tittagalla, A. Jayathilaka, U. Ilukpotha, R. Jayathilaka, P. Jayasinghe, Tourism and economic growth: a global study on Granger Causality and Wavelet Coherence, *PLoS ONE* 17 (9) (2022) 1–21, <https://doi.org/10.1371/journal.pone.0274386>.
- [73] L. Aguiar-Conraria, N. Azevedo, M.J. Soares, Using wavelets to decompose the time–frequency effects of monetary policy, *Phys. A Stat. Mech. Appl.* 387 (12) (2008) 2863–2878, <https://doi.org/10.1016/j.physa.2008.01.063>.
- [74] S. Lakshani, C. Sandaruwan, C. Fernando, G. Vidyapathirana, R. Jayathilaka, S. Munasinghe, From short to long term: dynamic analysis of FDI and net export in global regions, *PLoS ONE* 18 (9) (2023) 1–34, <https://doi.org/10.1371/journal.pone.0291301>.
- [75] I. Sandanayaka, D. Rathnayake, D. Athalage, P. Wijesuriya, R. Jayathilaka, Interweaving globalisation and growth: a causal exploration across income levels, *Soc. Sci. Humanit. Open* 11 (2025) 1–18, <https://doi.org/10.1016/j.ssoho.2025.101399>.
- [76] E. Kadozi, Remittance inflows and economic growth in Rwanda, *Res. Glob.* 1 (2019) 1–15, <https://doi.org/10.1016/j.resglo.2019.100005>.
- [77] K. Adams, R. Attah-Boaky, H. Yu, I. Chu, D. Mali, African continental free trade area and regional trade in ICT and digital technologies, *J. Int. Manag.* 30 (4) (2024) 1–22, <https://doi.org/10.1016/j.intman.2024.101156>.
- [78] A.L. Mohamed Kamal, M.E. AboElsoud, Modeling economic growth factors in Egypt: a quantile regression approach, *Heliyon* 9 (2) (2023), <https://doi.org/10.1016/j.heliyon.2023.e13143>, 1–16.
- [79] Enhanced Integrated Framework. (2007). Burkina Faso. Retrieved from https://www.enhancedif.org/system/files/uploads/burkinafaso_dtis_report_e_sep0720.pdf.
- [80] Malunda, D. (2012). Report for the African Centre for Economic Transformation (ACET) Retrieved from https://www.afdb.org/sites/default/files/documents/publications/economic_transformation_in_africa_the_case_of_rwanda.pdf.
- [81] L.H. Engstrom, The benefits of trade integration in the southern african customs union. Building a Common Future in Southern Africa, International Monetary Fund, USA, 2013, pp. 1–28.
- [82] World Bank Group. (2020). Creating markets in Côte d'Ivoire. Retrieved from <https://www.ifc.org/content/dam/ifc/doc/mgrt/cpsd-cote-d-ivoire-executive-summary.pdf>.
- [83] C. Nwani, B.N. Okezie, A.C. Nwali, J. Nwokeiwu, G.I. Duruzor, O.N. Eze, Natural resources, financial development and structural transformation in Sub-Saharan Africa, *Heliyon* 9 (2023), <https://doi.org/10.1016/j.heliyon.2023.e19522>, 1–15.
- [84] Karoui, H. E. (2021). Algeria, Morocco, Tunisia: North Africa gripped by turmoil. Retrieved from <https://www.institutmontaigne.org/en/expressions/algeria-morocco-tunisia-north-africa-gripped-turmoil>.
- [85] International Trade Administration. (2023). Algeria–information & communications technologies. Retrieved from <https://www.trade.gov/country-commercial-guides/algeria-information-communications-technologies>.
- [86] B.H. Dabiré, K.A. Soumahoro, Migration and Inequality in the Burkina Faso–Côte d'Ivoire corridor, in: H. Crawley, J.K. Teye (Eds.), *The Palgrave Handbook of South–South Migration and Inequality*, Springer International Publishing, Cham, 2024, pp. 223–245.
- [87] International Labour Organization. (2024). Report on the assessment of sources of data on international labour migration in Uganda. Retrieved from https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@africa/@ro-abidjan/@sro-addis-ababa/documents/publication/wcms_912716.pdf.
- [88] International Organization for Migration. (2022). IOM burundi-2022 year in review. Retrieved from Burundi: <https://www.iom.int/sites/g/files/tmzbd1486/f/files/documents/2023-04/IOMBurundi-YearinReview-2022-English.pdf>.
- [89] S.K. Ng'ang'a, E.H. Bulte, K.E. Giller, J.M. McIntire, M.C. Rufin, Migration and self-protection against climate change: a case study of Samburu County, Kenya, *World Dev.* 84 (2016) 55–68, <https://doi.org/10.1016/j.worlddev.2016.04.002>.
- [90] United Nations Trust Fund for Human Security. (2022). Gabon–a joint human security approach to strengthening prevention, protection and empowerment in mixed migration to gabon. 1–2.
- [91] International Trade Administration. (2024). Ghana digital economy. Retrieved from [https://www.trade.gov/country-commercial-guides/ghana-digital-economy#:~:text=General%20Trends%20Ghana%20ranks%2015,sector%20\(see%20related%20section\)](https://www.trade.gov/country-commercial-guides/ghana-digital-economy#:~:text=General%20Trends%20Ghana%20ranks%2015,sector%20(see%20related%20section)).
- [92] Hassoumi, S. A. (2017). Niger and its mining sector Retrieved from <https://www.cgs.gov.cn/dzdt/kjdh/2017kydh/kjcx/201709/P020170921522571774964.pdf>.
- [93] World Bank Group. (2025). The world bank in the Republic of Congo. Retrieved from <https://www.worldbank.org/en/country/congo/overview#:~:text=The%20oil%20sector%20accounts%20for,resources%20that%20remain%20largely%20untapped>.
- [94] K. Ksissou, A. El Kadri, M. El-Khodary, S. Trid, The tourism attractiveness of the Moroccan archaeological site of Volubilis: an analysis of the determinants through analytic hierarchy process (AHP), *Int. J. Geohist. Parks* 12 (4) (2024) 606–620, <https://doi.org/10.1016/j.ijgeop.2024.11.007>.
- [95] C. Lanouar, M. Goaid, Tourism, terrorism and political violence in Tunisia: evidence from Markov-switching models, *Tour. Manag.* 70 (2019) 404–418, <https://doi.org/10.1016/j.tourman.2018.09.002>.
- [96] World Bank Group. (2023). A strong commitment to human capital is an investment in Rwanda's future. Retrieved from <https://www.worldbank.org/en/news/feature/2023/12/03/a-strong-commitment-to-human-capital-is-an-investment-in-rwanda-s-future#:~:text=Rwanda's%20resolve%20to%20ensure%20a,will%20benefit%20generations%20to%20come>.

- [97] World Bank Group. (2024). Sierra Leone records progress in human capital development - but requires sustained investments to drive economic growth and reduce poverty. Retrieved from <https://www.worldbank.org/en/news/press-release/2024/03/25/afw-sierra-leone-records-progress-in-human-capital-development>.
- [98] Statista. (2025). Digital & connectivity indicators–Madagascar. Retrieved from <https://www.statista.com/outlook/co/digital-connectivity-indicators/madagascar>.
- [99] World Bank Group. (2024). Digital transformation drives development in Africa Retrieved from <https://www.worldbank.org/en/results/2024/01/18/digital-transformation-drives-development-in-afw-afw-africa>.
- [100] Ali, S. H. S. (2018). Globalisation: the threatening tool to the Egyptian identity and sense of nationalism 1, 1-6. doi:<https://digitalcommons.aaru.edu.jo/wrpsj/vol1/iss1/5>.
- [101] S. Diop, S.A. Asongu, C.T. Ndiaye, Supporting African union: do macroeconomic fluctuations matter? *Econ. Syst.* 48 (3) (2024) 1–10, <https://doi.org/10.1016/j.ecosys.2024.101186>.
- [102] M. Ahmad, P. Jiang, M. Murshed, K. Shehzad, R. Akram, L. Cui, Z. Khan, Modelling the dynamic linkages between eco-innovation, urbanization, economic growth and ecological footprints for G7 countries: does financial globalization matter? *Sustain. Cities Soc.* 70 (2021) 1–13, <https://doi.org/10.1016/j.scs.2021.102881>.
- [103] P.B. Beri, G. Mhonyera, G. Nubong, Globalisation and economic growth in Africa: new evidence from the past two decades, *S. Afr. J. Econ. Manag. Sci. (SAJEMS)* 25 (2022) 1–13, <https://doi.org/10.4102/sajems.v25i1.4515>.
- [104] K. Konadu-Agyemang, The best of times and the worst of times: structural adjustment programs and uneven development in Africa: the case of Ghana, *Prof. Geogr.* 52 (3) (2000) 469–483, <https://doi.org/10.1111/0033-0124.00239>.